EVENING.

From the Painting by Karl Heffner in the Victoria and Albert Museum.

THE NATURE BOOK

A POPULAR DESCRIPTION BY PEN AND CAMERA OF THE DELIGHTS AND BEAUTIES OF THE OPEN AIR

* *

CASSELL AND COMPANY, LIMITED
LONDON, NEW YORK, TORONTO AND MELBOURNE
1913

ALL RIGHTS RESERVED

CONTENTS

PAGE

AMPHIBIANS, HOW TO KNOW THE. *By* DOUGLAS ENGLISH, B.A., F.R.P.S. *With Photographs by the Author.*

THE NEWTS . . . . . 448 | THE FROGS AND TOADS . . 480

ANIMAL EPICURES. *By* GERVAISE TURNBULL 652

ANIMALS, HOW TO KNOW THE WILD. *By* DOUGLAS ENGLISH, B.A., F.R.P.S. *With Photographs by the Author.*

THE POLECAT AND MARTEN . 391 | THE SQUIRREL 646
THE WATER RAT . . . . 416 | THE BADGER 675
THE BROWN HARE, THE RABBIT 607 | RATS AND RATTONS . . . 743

ANIMALS, HOW, SHOULD BE HANDLED. *By* J. H. POWELL. *With Photographs by the Author* 529

BEES AND THEIR WAYS. *By* T. H. YELDHAM 430

BIRDS, HOW TO KNOW THE. *By* THE REV. MAURICE C. H. BIRD, M.A., M.B.O.U.

THE WADERS . . . 400, 442 | THE SWIMMERS . . . 655, 705
THE RAILS, MOORHEN AND COOT 539 |

CLIFFS AND THEIR STORY, THE. *By* F. MARTIN DUNCAN, F.R.P.S. *With Photographs by the Author* 437

FALL OF THE YEAR, THE. *By* R. A. STAIG 373

FISH, BRITISH FRESH-WATER, AND THEIR HAUNTS. *By* WALTER M. GALLICHAN. *With Photographs by* MRS. C. G. GALLICHAN.

THE SALMON . . . . 424 | PIKE AND PERCH . . . 565
THE SALMON TROUT . . . 496 | BREAM, ROACH AND RUDD . . 738

GARDEN IN WINTER, THE. *By* H. H. THOMAS 469

GRASSES. *By* MAUD U. CLARKE. *With Photographs by* HENRY IRVING.

GRASSES OF THE HAYFIELD . 475 | GRASSES, THE HILL . . . 575
GRASSES OF THE MOIST PLACES . 515 | GRASSES OF THE WOODS . . 603
GRASSES OF THE WASTE PLACES. 544 |

INSECTS, HOW TO KNOW THE. *By* JOHN J. WARD, F.E.S. *With Photographs by the Author.*

THE "WOOD WASP" AND SOME AUTUMN INSECTS . . 491 | IN WINTER QUARTERS . . . 629

KINSHIP OF PLANTS TO ANIMALS, THE. *By* WALTER P. WRIGHT . 749

LAKES AND THEIR FORMATION. *By* J. LOMAS, F.G.S., A.R.C.S. . . 597

MOULDS, THE STORY OF THE. *By* JOHN J. WARD, F.E.S. *With Photo-Micrographs by the Author.* 688

NATURE "IN TOWN." IDYLLIC BATTERSEA. *By* ARTHUR SCAMMELL . . 456

"OAK APPLE," WHAT IS AN? *By* HAROLD BASTIN. *With Photographs by the Author* 693

POND LIFE. *By* F. MARTIN DUNCAN, F.R.P.S. *With Photographs by the Author* 592, 670, 719

REPTILES, HOW TO KNOW THE. *By* DOUGLAS ENGLISH, B.A., F.R.P.S. *With Photographs by the Author.*

THE LIZARDS . . . . 501 | THE GRASS SNAKE, THE SMOOTH
THE ADDER, OR VIPER . . 549 | SNAKE 580

PAGE

RUSHES, THE. *By* MAUD U. CLARKE. *With Photographs by* HENRY IRVING . 715

SEASHORE, THE LIFE OF THE. ANEMONES, SPONGES, ETC. *By* F. MARTIN DUNCAN, F.R.P.S. *With Photographs by the Author* . . 379

SEDGES, THE. *By* MAUD U. CLARKE. *With Photographs by* HENRY IRVING 657, 666

SNAIL, THE GARDEN. *By* JOHN J. WARD, F.E.S. *With Photographs by the Author* 735

SNOWBOUND ANIMALS. *By* WALTER M. GALLICHAN 461

SNOWFLAKE, THE STORY OF A. *By* J. LOMAS, F.G.S., A.R.C.S. . . 556

STONE-TURNING. *By* R. A. STAIG. *With Photographs by* JOHN A. BALLANTYNE 519, 571

THUNDERSTORMS, CONCERNING. *By* WILLIAM J. S. LOCKYER, M.A., PH.D., F.R.A.S. *With Photographs by the Author* 618, 639

TREES GROWING IN BRITAIN, HOW TO KNOW THE. *By* HENRY IRVING. *With Photographs by the Author.*

THE WILLOWS . . . 386, 412
THE ELMS 464
THE ASH 487
THE MAPLES 523
THE HORSE CHESTNUT, THE LIME 559
THE PLUM AND CHERRY GROUP . 587
THE APPLE AND PEAR GROUP 614, 634
THE ELDER, THE HOLLY, THE LABURNUM, AND THE ACACIA . 681
THE CONIFERS—FIRS AND PINES . 709
THE CONIFERS—LARCH, CEDARS, CYPRESSES AND YEW . . 729

VALLEYS, AND HOW THEY ARE FORMED. *By* J. LOMAS, F.G.S., A.R.C.S. 405

VERNAL DAYS. *By* R. A. STAIG 725

WILD FLOWERS, HOW TO KNOW THE. *By* THE REV. H. PUREFOY FITZGERALD, F.L.S. *With Photographs by* HENRY IRVING.

THE FLOWERS OF THE HEDGE-CLIMBERS . . . 434, 533
THE FLOWERS OF THE CHALK DOWNS AND PASTURES . . . 622
THE FLOWERS OF THE HEDGEROWS 698

WILD GARDEN, THE. *By* H. H. THOMAS 661

WINTER IN EXCELSIS. *By* ARTHUR SCAMMELL 509

LIST OF PLATES

EVENING. *From the Painting by* KARL HEFFNER *in the Victoria and Albert Museum* . . . . . *Frontispiece*

STORMY WEATHER. *From the Water-Colour Drawing by* LEOPOLD RIVERS *in the National Gallery of British Art* . . . . . *Facing p.* 405

BIRCHES AT FAIRCROP. *From the Water-Colour Drawing by* MRS. RAWNSLEY . 437

THE BEACH AT RAMSGATE. *From the Water-Colour Drawing by* J. BUXTON KNIGHT *in the Victoria and Albert Museum* 469

WINTER. *From the Painting by* R. W. ARTHUR ROUSE 501

THE GARDEN, ST. ANNE'S, DUBLIN. *From the Water-Colour Drawing by* E. A. ROWE 533

COTTAGE AT ROUNDHURST. *From the Water-Colour Drawing by* SUTTON PALMER 565

THE SOUTH DOWNS. *From the Water-Colour Drawing by* COPLEY FIELDING *in the Victoria and Albert Museum* 597

A WARWICKSHIRE COTTAGE. *From the Painting by* A. C. WYATT 629

THE CLOCK TOWER, ST. ANNE'S, DUBLIN. *From the Water-Colour Drawing by* E. A. ROWE 661

SPRINGTIME. *From the Painting by* A. C. WYATT 693

THE CLIFFS IN JUNE, CORNWALL. *From the Painting by* ARTHUR J. BLACK . . 725

Photograph by J. H. Powell.

THE TOUCH OF AUTUMN.

THE FALL OF THE YEAR

By R. A. STAIG

"Where are the songs of Spring? Ah, where are they?
Think not of them; thou hast thy music too."—KEATS.

HALLOWTIME and the little ones ducking merrily for ruddy apples in the domestic tub—what tremendous excitement! Not in their little hearts can they feel, as we do, the sadness of the withering and the dying down. Feeble grows the sun; comes the increasing cold, and with the first shocks of frost the chill grey mists of autumnal morning. Dense dews bespangle blade and leaf with glistening gems. A singularly beautiful thing the iridescence of these scintillating dew pearls gathered on the gossamer webs; and what astonishing profusion of this gossamer! Scarce a hedgerow without its filmy network; spread over the fields, entangled in the grass, floating in the air, countless silken threads, spun from the spinnerets of restless little spiders. In the calm of a sunny autumn morning thousands of them mount the herbage and the fence-tops, cast the "ballooning" thread, and on tip-toe await the favouring breeze. A little leap, and the spiderlings vanish into space on the wings of the wind—the "gossamer flight," so prophetic of the wintry days to come. Many float high, lengthening the thread as they go; others, drawing in the silk,

sink lightly once again to earth, but a stone's-throw it may be from the thistle-top of embarkation.

The bramble leaves are many shades of crimson now, the wild rose brown and crumpled; but there is all the gloss and glory of the reddening hip. The limes are bare, the sycamore reduced to drab and yellow rags, the horse-chestnuts dingy; but the elms are still gloriously yellow, and the roadside hedges brighter than they have been for weeks, bronzed hawthorn and ruddy-hued beech leaf commingling.

Photograph by J. H. Powell.

THISTLEDOWN.

Green lingers on, but the withering pinch of Autumn is upon it. Russet tints and brown deepen in the dying foliage like a great stain. The leaf's labours are nearing a close. Beneficent in life, dying it gives to the tree that will yet weather many a storm all that it has worth having. It seems but a day since the swallows twittered so loquaciously under the eaves. They are gone long since, a wild, excited rush to the sunny south; many a dreary month to be lived through ere they come again with Spring. Memory creeps back to those warm September hours by the wayside, hours of the yellow corn and the ripened seed. 'Twas a pleasing sound, the splitting and cracking of innumerable pods and capsules in the heat of the sun; quite a pleasure, too, watching the little violets and hedge geraniums throw forth their seeds to fate or fortune. A quick succession of little explosions from among the whins and broom announced the dispersal of new whin and broom generations; and in the garden the artillery of the noli-me-tangere balsam—touch it and prove the "impatiens"—out-shot the seeds in every direction. The thistledown floating hither and thither in clouds as the breeze strengthened; how suggestive of the Fall these tiny nutlets borne away on the daintiest of parachutes. One marvels at the ingenuity displayed for securing the widespread dispersal of seeds. For what purpose the prickles of the burdock burr, or the minute hooks on the "cleaver" fruits of the sticky goose-grass? None other than to cling, for a time, to fleece and fur and feather. Why the wings of the maple fruit?—watch its twisting fall. But the poppy capsule presents a puzzle. When it cracks, little windows open just under the crown. When the rain comes little eaves protect the open windows. Only when the wind sways it to and fro will you see how the seeds roll out, one by one. Though the thrush devours the rose hip, the seeds are sown none the worse for their intestinal travels; nor is there any reason to suppose that the squirrel's hoards of nuts are destined to be eaten, for the squirrel has a habit of forgetting where he puts things. What amazing prodigality, and how providential, too, is all this broadcast seed-scattering.

How well one remembers the comfortable *coo roo, coo, oo-oo* of the cushat in the fir-tops through the sleepy hours of the warm September afternoon, and the

sweet singing of wrens and accentors in the shrubberies so pleasing to the ear; but now a great silence has begun to cast its glamour over all.

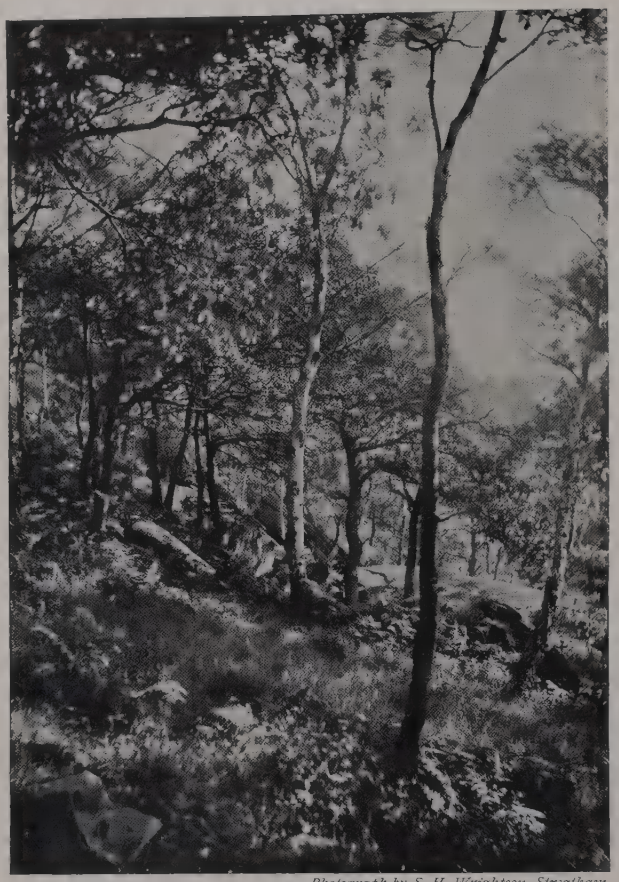
No more the buoyant carolling of happy birds, no longer the incessant hum of countless insects, "a wailful choir the small gnats mourn." Hushed all the music of the gladsome Summer time. A different note now breaks the stillness; it is whispered by the falling leaf, we hear it in the plaintive cries of passing birds, louder in the stubble, what a clamouring and commotion there; louder still, the rocking and creaking of the half-stripped trees as Boreas, the great north-easter, shrieks through them in spasms of gathering fury, scattering everywhere the withered leaves and snapped dead twigs.

Not long since I found a belated bee clinging to a faded flower in my little garden; it scarcely moved when I breathed upon it, for its strength was failing fast. Night set in with a numbing cold. When I went again next morning the blossom had fallen, the blossom where a merciful drowsiness overtook it in a last vain search for food, and beneath it the bee lay stiff, many a dead leaf near, their life-work at an end.

Many nests among the bushes look as good as on the day they were built, though it is long since the fledglings left them. Whole families have joined the general exodus to the stubbles, far from the favoured haunts where they chirped and whistled and sang so long. Thrushes, tits, hedge-sparrows and robins remain to dispute the stores of berries and seeds with the immigrant strangers from colder climes, who have now begun to put in an appearance in the depopulated bird quarters. Harmony has given place to squabbling and pecking. No mild affair the struggle for existence when Winter sets in in earnest, and food supplies dwindle. What between hungry "blackies" and fieldfares, and incessant persecution by the lesser birds, friend "stormcock" has an anxious time over the delectable berry; "'the fewer guests the merrier' saith the instinct of the bird."

Gulls are grouped together on the pasture like white statues; every now and then one rises to rob a hapless peewit of its worm. Rooks straddle about, inquisitive, with grotesque airs of self-importance. Noisier than ever, their language adds a feature to the season, an odd jargon of the queerest croaks and gurgles. Grey crows seem to consort a good deal just now with their black brethren. November is said to be the month when rooks revisit their old nests to repair them, but apparently nothing so serious occupies the rook mind. As a matter of fact, observation finds him greatly addicted to tomfoolery amongst his sticks. What prodigious numbers of sparrows and finches have assembled in the fields! Whole congregations of twittering linnets and dense flocks of starlings rise from the stubble! The migratory instinct and its concomitant restlessness explain these immense fore-gatherings of birds and the hubbub which ensues. A great fuss they make over the going, always bidding excited good-byes, and then coming back again and again to say something more before finally taking leave. It is no light undertaking, their annual pilgrimage; many will never return. Conceive the difficulties and life risks of a journey across the trackless ocean, through raging storms and in the darkness of the night! It is well known that certain migratory birds travel distances greater even than ten thousand miles! Look at a map and think of a journey from the Arctic to New Zealand! Even more wonderful is the speed at which they travel, often exceeding one hundred miles an hour—"the dotterel sups at sunset on the North African steppes and breakfasts next morning on the Arctic Tundra!" For days on end, without interruption, whole square miles of birds may be seen winging their way high up in the heavens. Marvellous indeed this wing-power, and amazing the sense of direction.

Heavy rains and floods soak the country like a sponge and soil the beauty of the tall autumn flowers. Colour is fading fast in the herbaceous border. The yellow evening primrose, the helianthus and the golden rod have lost their lustre. Phloxes and anemones have shed their whites and pinks; the giant hollyhocks are dying down. A few more days and the glowing scarlet of the torch



Photograph by S. H. Wrightson, Streatham.

"RUSSET TINTS AND BROWN DEEPEN IN THE DYING FOLIAGE."

lily will be but a memory of the October sun.

These are the heavy, clouded days of dismal dullness, damp and depressing, chilling to the very marrow. Even the least sensitive among us feel the subtle influences of this season of the dun and the decadent, as we plod our way, querulous, over the plashy mud, or hug the study fire when the wind is grumbling and moaning in the chimney. Man, like the birds, grows fidgety as Winter draws near; we would seek with them the sunnier clime, we like not the restraint which circumstances impose on us.

At this period the city reminds one of the feathered communities in the stubble. A crowding together for common benefit; greater social intercourse, our house to house visitations, our convivial gatherings; all sorts of plans and preparations for checkmating the wintry incubus. With the last crimson flush of the Virginian creeper, and the passing of chrysanthemum and dahlia, the outer world is forgotten, living only in the fitful fancy of some Christmas snow scene. Whatever the weather conditions we do not care to think much about them, so comfortable our retirement amid our household gods. There is no denying the city's thousand charms in Winter; yet beyond the city all is not so lifeless and destitute of pleasure as we are wont to imagine. We who live the town life, seldom communing with Nature, our visions of the country-side at Fall-time are too much the browned, drear waste with Death, the Phantom, over all. 'Tis a very different picture which the habitually observant country dweller would paint, without a touch of autumnal pessimism; so much to be seen everywhere around him, so many interesting changes and happenings; on every hand fresh evidence of a continuance of life, and all to be recorded, with such happy, reverent care, in his calendar of country days. Though the leaves have fallen, the new buds formed some months ago remain upon the branches wrapped up tightly in their winter cloaks of protective scales. The summer butterfly is dead, but in sheltered nooks we discover the coming generation sleeping safe within their chrysalid cradles. The fields are not yet flowerless, not yet without colour; the ragwort still spreads its gold; here and there some purple knapweeds, a mauve thistle, a white dead-nettle, a blue harebell. There are yellow stars on the fleabane, a few pink bramble blossoms, buttercups in plenty, and the pink persicaria.

Already countless eggs and larvæ are quiescent under the still waters like the

fruits and seeds in the ground. Cold produces a providential drowsiness—most of our animal Rip Van Winkles are preparing for their winter nap. Fat toads lie snug under earth, and the frogs are sound asleep beneath the mud in the ponds. The ants are busy storing provisions—some of them store grain, actually biting the embryos to prevent growth. Certain ants take their cows—the aphis flies—with them into their dormitories. The snail shuts itself in completely, closing up the mouth of its shell with a hard, limy lid. A very industrious person is a hedgehog in Summer, searching out and devouring enormous quantities of grubs and worms. Autumn sees him corpulent and lazy, desirous of a quiet resting place. A mass of crumpled leaves among the roots of a hedge makes a fairly comfortable hibernaculum for a hedgehog. There you will find him curled up like a ball, a heavy sleeper, not to be wakened easily until Spring; eating no food, but "burning his own fat." The squirrels are busy selecting acorns and beech-mast. How knowingly they guard against want by distributing their hoard over a wide area, hiding away the various nutty titbits in so many different places. So erratic is the course of our seasons, a mild, sunny day in December no more surprises us than does a wintry one in Summer. It is these brief spells of sunshine which afford proofs in plenty wherewith to counteract our gloomy and erroneous ideas of a dearth of life in Winter time. Light sleepers like the squirrel, the dormouse, and the harvest mouse waken up then, and leave their quarters to enjoy a nibble of food and a freshened toilet before resuming the business of hibernation. These gracious intervals of genial warmth bring the daisies out to star the lawn, and induce the drowsy dor-beetle to indulge in a constitutional; numbers of spiders issue forth from the crevices in the tree-trunks, where they had tucked themselves in; bats flit to and fro, and the winter moths

Photograph by F. H. Powell.

"A DIFFERENT NOTE NOW BREAKS THE STILLNESS; IT IS WHISPERED BY THE FALLING LEAF."

flicker along the hedgerows. Even in the keen, frosty days of mid-December we hear the "twink" of the chaffinch, the incessant "chink, chink, chinking" of the blackbird, and the thin, piping notes of hedge-sparrows and blue tits; and, sun or no sun, the starling still "fizzles" on the chimney-pot. Evergreen, holly, and ivy festoons grace the woodlands, and mosses grow thick and deeply green. The giddy gnats still dance in the humid shade.

The evening of the year is a busy time of preparation for a fresh continuance of life. The plant dies down, but the stores accumulated in Summer are gradually transferred to the roots which live on. The buds upon the branches are stores. Within the seeds which have been scattered broadcast there are stores; and what are root-stocks, bulbs, and tubers, but life held over in reserve for another year. Your succulent fruit, your rosy-cheeked apple that is the characteristic thing of the season, the triumph of the year's work. And what does it tell you when you split it open? This, that the purpose of every living thing on Earth is to perpetuate a futurity through the fruits of a busy life. Cradled within the apple are the seeds of a new generation. Let it serve as symbol that Fall-time is not an end of life, but a period of fruitage and recuperative rest prior to continuance and a new beginning. When Spring comes the life that went away will again return to remind us that the farewell, which seems for ever, is really only "au revoir."

But however things may be, and they are certainly dismal enough when Winter howls, and cold rains lash at the pane, let us take a hint these days from the cheery trill and sharp staccato reminder of the perky little gentleman with the red waistcoat; for what is a robin in winter but a veritable living personification of our old friend Mark Tapley, "there is a credit in being jolly under any circumstances." R. A. STAIG.

Photograph by S. H. Wrightson, Streatham.

"LOUDER STILL, THE ROCKING AND CREAKING OF THE HALF-STRIPPED TREES AS THE GREAT NORTH-EASTER SHRIEKS THROUGH THEM."

A GOOD COLLECTING GROUND.

THE LIFE OF THE SEA-SHORE

By F. MARTIN DUNCAN, F.R.P.S.

Illustrated with Photographs by the Author

ANEMONES, SPONGES, &c.

AMONGST the most beautiful and interesting treasures of the rock pools are the Sea Anemones. They are very numerous, and one should have but little difficulty in collecting quite half a dozen different kinds on any rocky coast during a holiday by the sea.

Perhaps the most familiar of them is the pretty little "Beadlet" or "Strawberry" Anemone (*Actinia mesembryanthemum*), which is to be found on most shores, attached to stones, seaweed, timber, or the sides of the rock pools. When closed the Beadlet Anemone looks for all the world like a little rounded, dark red or greenish lump of jelly, soft and slimy to the touch, and adhering so firmly to the rock or timber as to be difficult of removal without injury. The best plan is to chip off the piece of rock to which it is fixed, or if the Anemone is attached to soft chalk or timber, to work gently with a knife so as to cut away a thin layer of the substance to which it adheres. If we now transfer our treasure to a glass vessel filled with fresh sea-water, we shall presently see the little lump of jelly expand, and the numerous feelers, or tentacles, spread out in a circle round the disc, in the centre of which is the hungry mouth of the little creature. If we look carefully, we shall see that where the outside set of tentacles join the side of the body there is a curious fold of skin which goes all round the Anemone's body, and that between this fold and the tentacles there is a series of beautiful bright blue, beadlike bodies from which the little creature takes its popular name.

THE "BEADLET" OR "STRAWBERRY" ANEMONE.

Although the Anemones move too slowly to "go a-hunting," they are nevertheless fully equipped with a very wonderful apparatus for capturing the various creatures on which they feed. This apparatus consists of almost countless complex sting-cells or *Nematocysts* (from the Greek *nema*, a thread, and *cyst*, a cell), which cover the waving, sensitive tentacles. Within each of these cells is coiled a fine thread which terminates in several sharp barbs, and is kept in its coiled position within the cell by a curious little "trigger" hair. Now when a tiny shrimp, or other denizen of the sea, in its wanderings approaches an Anemone and brushes against one of the waving tentacles, it touches a number of these trigger hairs, with the result that the sting-cells instantly contract and shoot out the barbed hairs, which penetrate and stick into the flesh or skin of the unsuspecting victim, and at the same time an irritant fluid is injected which causes paralysis or death to a small animal. The more the victim jerks about, the more sting-cells are shot forth into its body; the tentacles close upon it, and the unfortunate creature is thrust down into the hungry and expansive mouth of the Anemone.

In the tidal pools on rocky shores may be found the beautiful Opelet or Snake-locked Anemone (*Anthea cereus*), which varies in colour from grass green to drab, according to its environment. The tentacles of this Anemone are long and slender, and are kept constantly moving. Fairly common on the south and west coasts of England are the Daisy Anemones. When fully expanded, they have a long, slender body, with a broad, flat, circular disc, and small, numerous, white-spotted, yellow-brown tentacles, while the outside of the disc and body are dotted with small white warts.

The largest and most gorgeously coloured of our native Anemones is the handsome Dahlia Anemone (*Tealia crassicornis*), which measures from four to eight or nine inches across its extended tentacles. It varies considerably in

THE SNAKE-LOCKED ANEMONE.

colour, through beautiful shades of deep and brilliant crimson, to orange, lilac and purple: in some specimens the disc is a beautiful crimson, while the short, stout, yet gracefully tapering tentacles are pure white. Although common on most shores, for it lives near low-tide mark and in the deep water beyond tide mark, the Dahlia Anemone may often be overlooked, so closely, when contracted, does it resemble its surroundings. Its columnar body bears upon the outer surface numerous suckers, which attach themselves to small fragments of pebble and shell, so that when the Dahlia Anemone contracts its tentacles, it looks at a short distance like a little rounded hump in the sand. If, however, we seek for it amongst the deep rock pools close to low-tide mark, we shall be pretty sure to be rewarded by a view of this handsome Anemone in all the glory of its fully extended tentacles, when it does, indeed, look like a flower of the deep.

THE DAHLIA ANEMONE.

In contrast to the giant Dahlia Anemones are the diminutive little Corynactis Anemones, not much larger than good-sized peas, which abound on certain parts of the Devon and Cornish coasts. Usually living together in colonies, of lovely white, green, red, or magenta tints, they present a very beautiful appearance.

One of the most remarkable of our Anemones is the so-called "Parasitic Anemone" (*Adamsia parasitica*), which is generally to be found attached to a whelk-shell tenanted by a Hermit Crab. The relationship existing between the Hermit Crab and the Anemone is a very interesting one, for the latter is not really parasitic, inasmuch as it does not live upon, and at the expense of, the Hermit Crab. These two animals are really what is termed "commensals," or messmates. The advantage to the Anemone of the means of comparatively rapid transit to places where food is to be found is obvious: while if we watch the Hermit Crab tearing with its pincers the food it has found, we shall see that many fragments escape and are captured by the tentacles of the Anemone, and quickly devoured. This Anemone is a very graceful little creature; its columnar body measures about two inches in height by one inch in diameter, and is striped with chocolate and white markings; the delicate fluffy-looking tentacles are of a whitish or pinkish hue. When angered or alarmed this Anemone throws out from its mouth, and from large pores on its body, masses of white glutinous threads, in which are embedded innumerable spindle-shaped bodies composed of carbonate of lime, and at the same time it gives forth a very strong, unpleasant smell. These two peculiarities of the Anemone are, in turn, probably useful to the Hermit Crab, in discouraging the attentions of unwelcome visitors, who

but for the presence of the malodorous, thread-secreting Anemone, would quickly gobble him up.

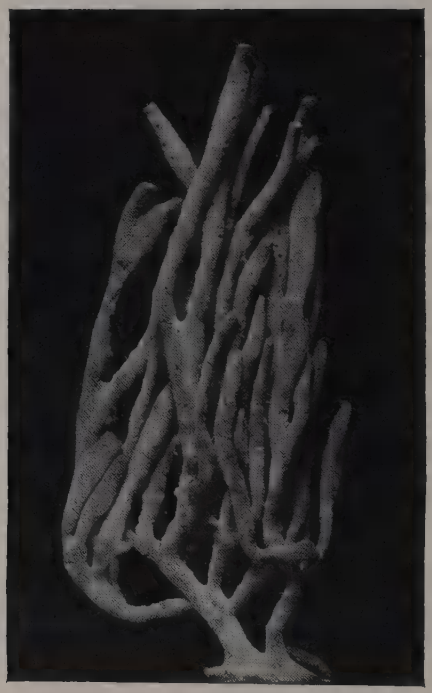
A LIVING ALCYONIUM POLYP.
(The "Dead Man's Fingers," or "Cow-paps.")

Very different in general appearance from the Anemones, although they form the link between them and the compound corals of the tropical seas, are those fleshy-looking masses so frequently to be seen cast up on the shore after a gale, and called "Dead Man's Fingers," or "Cow-paps" (*Alcyonium digitatum*). If we examine one of these masses, we shall find that it is soft to the touch, and that it has been attached by its base to a stone or rock: it is sometimes to be found growing in knob-shaped masses on old scallop shells, in company with graceful sprays of Zoophytes. There is one species of Alcyonium that may be found in the pools at low-water mark adhering to the rocks and weed.

In general colour, the body-mass of the "Cow-paps" varies from a yellowish-white buff to orange-red. If one is closely examined it will be seen that the body is covered with numerous bumps or papillæ. On placing one of these "Dead Man's Fingers" in a vessel filled with fresh sea-water, if still alive, it will soon present a very remarkable appearance, for each of the little papillæ will be seen slowly to expand into a lovely flower-like animal, and its graceful, petal-like tentacles will slowly sway about and capture small living organisms: so that, what a few moments before looked a curious, rather unpleasant mass, becomes converted into a beautiful object—an active animal colony.

Although generally missed or passed over by the casual visitor, quite a number of interesting Sponges are to be found in the rock pools, and growing upon sea-weeds and other objects. The "Crumb of Bread" Sponge (*Halichondria panicea*) may be found at its best about the region of the half-tide, forming masses of from six inches to several feet in diameter, and varying in thickness from half an inch to two or three inches. It is a Sponge that varies very greatly, both as regards size and colour. In situations where but little light can reach it, the "Crumb of Bread" Sponge will be found growing in an almost white mass, while in other and more favourable conditions of lighting it may be found forming large masses green or yellow in colour.

Oyster-shells whose surfaces are more or less covered with small round holes



A COMMON BRANCHING SPONGE.

are common objects of the sea-shore. These holes are caused by a little burrowing Sponge called Cliona, which eats its

way into the oyster-shell. If closely examined, it will be seen that the holes are of two sizes, and that the smaller are by far the more numerous; while, on carefully splitting the shell open, it will be found that both sized holes communicate with irregularly swollen canals, which are occupied by the somewhat yellow-coloured body of the Sponge. If we take one of these shells infested with Cliona from a rock pool, and place it in a vessel containing clear sea-water, we can watch the little Sponges expand, and see the water currents passing in and out.

The branching Sponges, which grow in the form of graceful, slender stems, are well worth seeking, and when seen alive in their natural haunts are very varied in colour,

FIVE-FINGERED AND CUSHION STAR-FISHES.
Note that on one of the stars new arms are growing to replace lost ones.

ROSY FEATHER STAR-FISH.

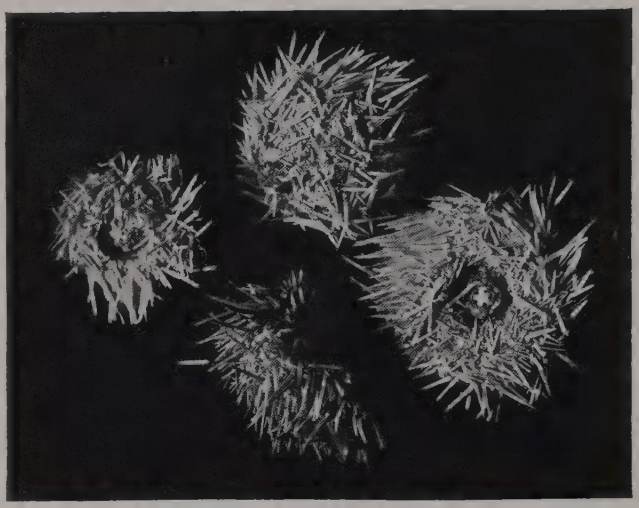
some being pale yellow, orange, red, crimson, or a deep purple. To anyone possessing a student's microscope, the Sponges offer most interesting material; their wonderful spicules form most beautiful objects, while a small portion of a living Sponge, placed in a flat-bottomed watch-glass partially filled with sea-water, will present one of the most interesting and remarkable sights that the microscope can reveal to us. If we move the watch-glass about on the stage of the microscope until one of the apertures on the side of the piece of Sponge is in focus, we shall see quite a miniature torrent gushing forth from the opening, bearing minute opaque particles along at a rapid rate.

A Star-fish left stranded on the shore by the receding tide is a familiar sight to all who delight to wander by the sea. It is a singularly helpless-looking animal as it lies on the shore, and one would never suspect that such a limp, flabby creature was capable of doing serious damage, or that it could be the hated foe of anyone. Nevertheless the Common Star-fish is the ancient foe of all oyster fishermen, for it haunts the oyster beds, and devours innumerable oysters.

Besides the Common Star-fish, which, by the way, has many popular names, such as "Five-fingered Jack," "Old Cramps," and "Devil's Hand," there are many interesting and beautiful specimens to be found. One of the handsomest is the Sun Star-fish (*Solaster papposa*), which frequently measures, when full grown, seven or eight inches across. It is a very striking-looking creature, with its numerous tapering arms—which remind one of primitive drawings of the sun's rays—and its fine, bright red and white colouring. Amongst the rock pools, and

under loose, flattish stones, may be found the plump little Cushion Star-fish (*Asterina gibbosa*), which has no definite arms, but only five projecting corners.

To find the dainty little Sand and Brittle Star-fishes, we must seek along the stretches of sand at low-tide mark, and in the clear rock pools. Graceful in shape, delicately tinted, extremely fragile, these little Star-fishes must be handled with great care, or numerous arms will be missing long ere the little creatures are brought back from the afternoon ramble. One of the treasures to be found amongst the rock pools is the beautiful Rosy Feather Star-fish (*Antedon rosacea*), with its graceful, deep red, plume-like rays or arms. It is a most intensely interesting as well as a beautiful creature, on account of its somewhat remarkable life-history. The Rosy Feather Star-fish starts life as a little oval, comparatively active, free-swimming creature: a little later it becomes attached to a rock, when it has a slender stalk, at the top of which the plume-like rays develop, so that the Rosy Feather Star now looks like a graceful, rayed flower—a sea-lily. After a time the beautiful flower-head breaks away from its slender stem and becomes an adult Feather Star. It is the stalked stage of the Rosy Feather Star-fish that is so interesting, for it represents a very ancient type of creature, which under the name of Stone Lily (*Encrenite*), is common as a fossil in the limestone rocks. Indeed, in past geological ages these Stone Lilies must have been very abundant in the seas which covered what is to-day dry land.



A GROUP OF SEA URCHINS.

While scrambling over the rocks and amongst the pools, seeking the Rosy Feather Star-fish, we are fairly certain to come upon one or two specimens of the common Sea Urchin (*Echinus miliaris*), the typical representative of a very interesting group of animals that are close cousins to the Star-fishes. At first it is a little difficult to realise that this prickly little creature, with its hard, shelly test or body plates, is a near relation of the Star-fish. If we place a living specimen in a glass vessel of sea-water, however, we shall be better able to recognise the relationship, for we shall there see that amongst the forest of spines with which the Sea Urchin is clothed, there are numerous suckers or tube feet arranged in a similar manner to those which run down the centre of the arms of the Star-fish; and it is by means of these tube feet that the Sea Urchin is able to move about, and in captivity to crawl up the glass side of the aquarium. If we carefully remove all the spines from the test or shell of a dead Sea Urchin, we shall be able to see what a wonderful and beautiful object the test is, and how it is perforated at regular intervals by holes for the protrusion of the tube feet.

A Crab hastily scuttling across the sands, or sitting back and holding out its powerful claws in an attitude of comical defiance, is one of the most familiar sights of the shore. Besides these common shore Crabs, there are many others that may be discovered during one's ramble along the sands and amongst the rock pools. In the latter situation we are almost certain to make the acquaintance of some of the curious, slenderly-built Spider Crabs, and the queer-looking

Hermit Crabs that laboriously drag their whelk-shell homes about with them.

In turning over some of the flat stones which lie half buried in the sand near low-tide mark, we shall disturb many strange-looking creatures, amongst others some of the curious Marine Worms, which, with their external gills, bristle feet, and deeply segmented bodies, are much more remarkable and interesting creatures than their land-dwelling cousins. Some of the Marine Worms build wonderful coiled tubes upon the backs of old shells: and if one of these tube-covered shells be placed in a jar of sea-water the Worms will in a little time recover from their alarm, and cautiously thrust out their extraordinary, tufted heads, looking for all the world like miniature "Turk's heads," or sweep's brooms.

During our wanderings and probings amongst the rock pools, we shall also find that there are several species of fish that are to a greater or less degree dwellers in, or frequenters of, the pools. Lurking under stones and in crevices in the rocks at about half-tide mark, we

TEST OR SHELL OF A SEA URCHIN FROM WHICH ALL THE SPINES HAVE BEEN REMOVED.

shall find the curious little Bull-headed Shanney or Blenny. In the pools nearer to low-tide mark, and generally hiding under stones, the Rock Goby makes its home. As a rule the pool will be found to contain a pair of these rather prettily coloured fish. They rarely exceed five inches in length, and are olive-green in colour, with reddish and buff markings.

A BABY SEA-HORSE.

The Goby fixes its spindle-shaped eggs in close-set order to the under surface of the shelving rocks in the deep, quiet pools. The so-called "Sting-fish" or "Father Lasher" is a frequenter of the pools. It has a very large head in proportion to the size of its body, and bears four stoutish spines upon its gill covers. It has gained its popular name from its curious habit of swelling out its spine-clad gill covers when alarmed or disturbed, which gives it quite a formidable appearance. As a matter of fact, it does not sting, but nevertheless it should be handled with caution, as it is capable of inflicting a nasty, painful wound with its gill spines.

In weedy, rock-strewn pools may be found, too, the graceful and curious little Sea-horse, which has gained its popular name from its resemblance to a knight in a set of chess-men. The little creature is rather difficult to see and to capture, for it very closely resembles its surroundings and, when resting, remains almost motionless, attached by its prehensile tail to the stem of a seaweed.

To give anything approaching a detailed description of the almost countless forms of life that teem upon the shore between the boundary of high and low water marks, would fill the pages of "The Nature Book"

several times over, and still leave much to be described. Indeed, that is one of the great charms of the sea-shore; it is one of Nature's richest storehouses of wondrous and varied forms of life, that offer interest and pleasure unending to all who will but use their eyes and can appreciate beauty of structure and colour.

F. MARTIN DUNCAN.

HOW TO KNOW THE TREES GROWING IN BRITAIN

With Notes, descriptive and photographic, for their Identification in all Seasons of the Year

By HENRY IRVING

THE WILLOWS—I

THROUGH a curious misreading of an ancient incident the Willows have long been made to symbolise a brooding sorrow. It was not strange that, to the weary hearts of the exiled incitements to joyousness should have served rather to evoke the opposite emotions of bereavement and sorrow. "By the rivers of Babylon, there we sat down, yea, we wept, when we remembered Zion. We hanged our harps upon the willows in the midst thereof." To the undisturbed in heart the willows are suggestive of a serenely gracious joyfulness. Garlanding the rounded river pools, over which the gauzy-winged children of the air dance out their short day of life, and the swallow curves in swift flight, pausing but to dip its breast feathers in the alluring water, across which the kingfisher with arrow-like passage strikes its sky-blue trail, there, with lovely exuberant grace, the Willows keep homely festival. Even when rudely pollarded, though at first their club-headed trunks look gaunt and almost ridiculous, yet they speedily acquire a new kind of grace with the growing out of their long-spreading osier branches. If not when standing singly, yet in extended wavy line along the water margin, they possess qualities sufficiently picturesque to win regard, and, therewith, no little admiration for their brave recovery from cruel maiming.

The Willows are a tribe in themselves, with a multitude of related family groups. They vary in character and habit from tall, spreading trees to low-lying dwarfs which barely over-top the grasses; indeed, the smallest of them, with buried stem, scarce lifts its branch tips above the mountain mosses. They are not only numerous and various, they are most intricately involved, having hybridised almost without limit. An expert cannot always distinguish among them, or read off, without shadow of doubt every Willow's ancestry. It must suffice for us if we regard only certain broad characteristics and groupings of the Willow tribe, noting the more obvious distinctions, and holding all besides in more or less doubt.

Those Willows which grow into trees of size are the White Willow, the Crack Willow, and the Weeping Willow. Added to these as occasionals are the Almond-leaved and the Bay-leaved Willows. The Goat Willow, or Sallow, is also found as a small tree, but more often as a large bush, or as a hedgerow shrub. Other Willows grow naturally, or are grown artificially, as Osiers; whilst others, chiefly found at high altitudes, have, as has been mentioned, a dwarf and

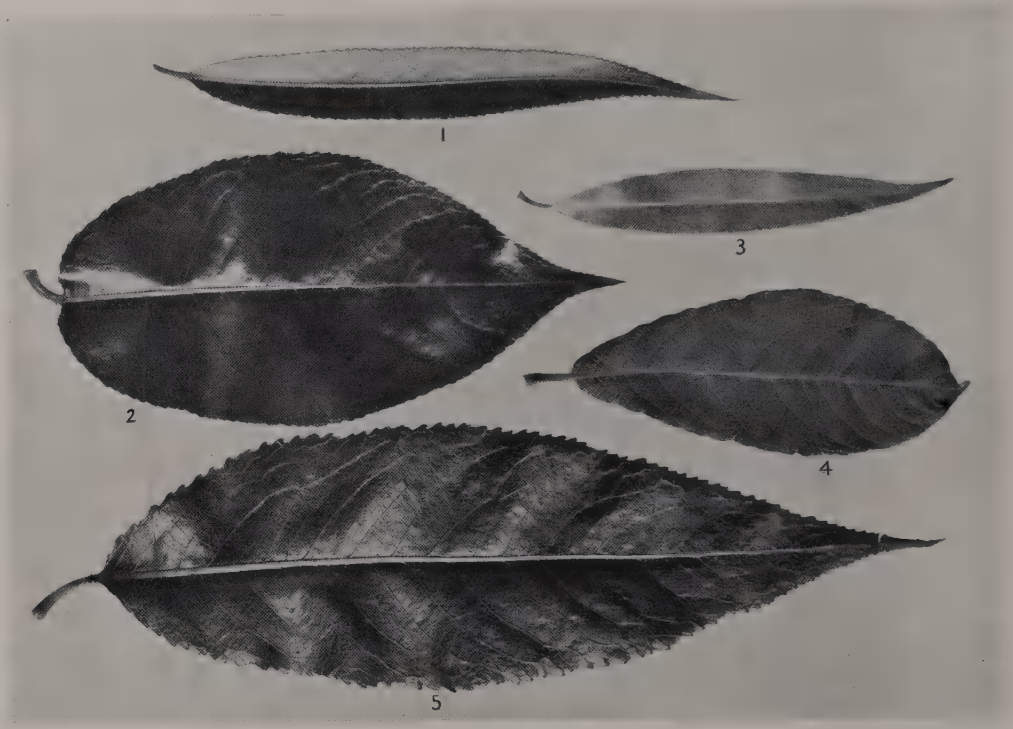
POLLARD WILLOWS.

WEEPING OR BABYLONIAN WILLOW IN SUMMER.

creeping habit, with their main stems on or under ground.

The *bark* of the Willows, in maturity, is thick and deeply furrowed. The *branches and twigs*, with the exception mainly of those of dwarf habit, are long, slender, and very pliant, justifying the name Willow, or "willing." The *buds* are arranged spirally on the twigs, and are generally long, pointed, and more or less pressed up against them. They are protected by a single scale, which is a rare characteristic among the buds of our trees. The leaf-scars are narrow, crescent-shaped, and show three or five leaf-traces. The *leaves*, speaking generally, are long and narrow, more or less lance-shaped; but there are considerable variations, as will be indicated. They vary in colour also, but mostly they are shining green on the upper surface and silky or cottony beneath. The latter quality is productive of that silver sheen in the Willows, which affords so marked a contrast against the heavier green of their companions, the Alders. The Willow leaf has a strong midrib, branching with many alternate secondary ribs, which, however, do not reach the leaf's margin, but bend over, and lose themselves in sub-division.

The *flowers* are grouped in catkins. The pollen-bearing catkins are distinct from the fruit-producing, and are borne on separate trees, after the manner of the Poplars. But the Willow catkins of both kinds are stiff and erect. Moreover, these catkins, with exceptions to be referred to later, are produced at the same time as the leaves, and attain maturity only when the tree is fully covered. They grow out as dwarf shoots from lateral buds on the previous year's twigs. These catkin shoots in some instances do, and in other instances do not, bear foliage also. Their erect attitude and late appearance mark a departure, and indicate a probable advance on the part of the Willows as compared with the



WILLOW LEAVES.

1, Crack Willow. 2, Bay-leaved Willow. 3, White Willow. 4, Sallow. 5, Almond-leaved Willow.

Poplars. The Willows do not entirely, nor indeed chiefly, depend upon the wind's agency for the conveyance of their pollen to the fruit-producing flowers. Both kinds of flowers provide nectar. Though these flowers exhibit no showy petals, their hidden sweets afford effective attraction to multitudes of insect visitors. The pollen dust also has undergone modification. Seen under the microscope it is not smooth as is wind-blown pollen, but roughened, and thereby better fitted to attach itself to the body or limbs of a welcomed visitor, by whom it is conveyed in due course to the next fruit-producing flower that is visited.

The *fruit* is produced in catkins which ripen in early summer, and appear as finger-lengths of cottony fluff. This fluff breaks away in the wind, and bears the seeds over the meadows, or floats with them down the stream, till place and conditions suitable for growth are found.

WHITE WILLOW IN WINTER.

THE WHITE WILLOW AND THE CRACK WILLOW

These are the most frequent Willow trees met with, either in their full-branched or in their pollarded form. There are also many varieties and hybrids of these. They have the typical lance-shaped leaves. Those of the White Willow are distinguished by the presence of silky hairs on the upper as well as on the lower surface—densely so when young—whilst those of the Crack Willow are nearly, or quite, hairless. In both the margins are toothed. A useful distinguishing fact is the presence on the leaf stalk of the Crack Willow, close up to the leaf, of two small protuberances (glands); these are absent from that of the White Willow. The small stipules, or rudimentary leaves, found at an early stage at the base of the leaf stalks, are narrow and pointed on the White Willow; broader, kidney or half-heart shaped, on the Crack Willow. These, however, soon fall after the leaves have expanded. The chief distinction is afforded by the action of the twigs. Those of the Crack Willow, otherwise supple as those of the White Willow, break off at the base, where, especially

in the spring time, they are brittle as glass. The fracture is a clean one, leaving no jagged edges. This procedure serves, perhaps, to put a check upon over-luxuriance. From this habit the tree derives its name. The twigs of the White Willow do not so "crack." The White Willow is so named because of the white, silky hairs which are found, not only upon the leaves, but also, to some extent, upon the buds

TRUNK AND BARK OF WHITE WILLOW.

and twigs. The twigs of the Crack Willow are green or yellow, and the buds ruddy or brown; both are smooth.

THE WEEPING WILLOW

The Weeping Willow (otherwise the Babylonian Willow) conforms most closely to the Crack Willow; but its twigs do not crack. These hang down pendulous in long festoons, which sweep the ground or dip into the water beneath. The leaves are narrow, dark green, and without hairs above, and lighter, bluish green below.

THE BAY-LEAVED WILLOW AND THE ALMOND-LEAVED WILLOW

These may be found as trees, but their habit generally is shrubby. They are sufficiently characterised by their name, since their leaves resemble in shape those of the shrubs specified; they have also faintly the odour of the laurel and the almond respectively. Those of the Bay-leaved Willow are broad, and about two and a half times as long as they are broad. They are rounded at the base, and suddenly pointed at the tip; their texture is almost that of a holly leaf, and of a like deep, brilliant green above, but paler below. When young the upper surface is slightly sticky. They have several small glands on the leaf stalk. Stipules, when present at the base of the stalk, are narrow. The leaves of the Almond-leaved Willow are also broad, but about four times as long as they are broad. They are bluntly pointed at the base, sharply at the apex, rather less tough, and not of quite so brilliant a green as those of the Bay-leaved Willow. Stipules, when present, are broad. The leaves in both instances are toothed. If an individual pollen-bearing flower of the Almond-leaved Willow be examined under a magnifying glass it will be found to possess three stamens. The Bay-leaved Willow flower has usually five stamens. All the other Willow flowers have two only, with the single exception of that of the Purple Osier, which has its two stamens merged into one.

HENRY IRVING.

WINTER TWIG AND RESTING BUD (ENLARGED) OF WHITE WILLOW.

POLECAT.

HOW TO KNOW THE WILD ANIMALS

By DOUGLAS ENGLISH, B.A., F.R.P.S.
Author of "Wee Tim'rous Beasties," "Beasties Courageous," etc.

THE POLECAT AND THE MARTEN

With Photographs by the Author

"And if I may descend to lower game, what pleasure is it sometimes with gins to betray the very vermin of the earth, as namely, the fitchet, the fulimart, the ferret, the polecat, the moldewarp."—*Venator, in "The Compleat Angler."*

OUR two remaining British Weasels, the Polecat and the Marten, are most difficult animals to study worthily. The difficulty is in part due to their shyness, and in part to their increasing scarcity. Though the Polecat is still common enough in certain localities, his range tends yearly to become more restricted, while the Marten presents us with the mournful spectacle of a native British animal on the verge of extermination.

In the course of my field experience I have only once seen a Polecat at large, and I have never yet been fortunate enough to encounter a Marten. I have, however, kept both species in captivity; and one Marten, whom I released by reason of his savage and untamable character, repaid this kindness by remaining in the grounds of my home for nearly six months. I was thus provided with an opportunity, probably a unique opportunity, of observing certain of the habits of this exquisitely graceful and beautiful creature within a restricted area, and under conditions which, so far as the animal itself was concerned, were completely natural. To these observations I will recur later.

for it will be convenient to consider the Polecat, who is intermediate in size between the Stoat and the Marten, before directing our attention to his more handsome and, I think I must in justice add, more attractive relation.

The Polecat has earned an unenviable notoriety from the twin scent-glands which are situated beneath the root of his tail.

POLECAT.

These glands occur in all mustelines, but in the Polecat their secretion is singularly noisome.

The Germans do not mince matters but call him simply "Stinkthier." The French "Putois" is equally significant; while our own vernacular "Foumart," an evident corruption of Foul Marten, shows that our forbears had seized on at least one characteristic before bestowing a title. A second English name, "Fitch" or "Fitchet," has a similar meaning, but the origin of "Polecat" itself is lost. Two ingenious explanations have been suggested: one that it is "Polish Cat," the other that it is "Poule Cat"—the cat who robs the hen-roosts. I cannot resist making a third—"Pole-shaped Cat." A reason for the termination may be found in the fact that most of the Weasels have been employed at one time or another as semi-domesticated mousers. It is almost certain, for instance, that the domestic Cat of the Romans was a Marten.

The power of emitting a fluid the dissipated aroma of which is repulsive and sickening to human nostrils, reaches its highest perfection in the New-World Skunks. Whether this power was originally a means of defence or a means of courtship, is doubtful. There is little doubt, however, that in the Weasel tribe it has come to be exercised in both directions. A trapped Polecat or Stoat will almost certainly bring his battery to bear on his prison, and it will be found that a trap thus infected is the best possible lure for another of the same species.

So far as defence is concerned, though we have no European animal to compare with the American Skunk, who can direct his emission with considerable force (many persons have been blinded by it), and who combines with this unpleasant character a tendency to rabies, an enraged Polecat is an awkward thing to deal with, not only by reason of his sickening effluvium, but also by reason of his ferocity. In Smiles' "Life of a Scotch Naturalist," a description of an encounter between

the naturalist and a Polecat, in which the former, Thomas Edward, was reckless enough, or sportsman enough, to rely solely on his hands, is of such a thrilling and extraordinary character that doubts have been cast on the truth of it. These doubts are, to my mind, singularly ungenerous. Edward was sleeping under cover, during one of his night expeditions,

POLECAT SLEEPING.

with a dead moorhen in his breast pocket. He was roused by the movements of a Polecat which had evidently scented the bird. Edward lay still until the Polecat had gained sufficient confidence to crawl over his body, and then seized him by the throat with the idea of strangling him. This was the commencement of a struggle between man and beast which lasted "nearly two hours," and which only terminated when Edward succeeded in uncorking a phial of chloroform which he habitually carried with him. Exception has been taken to the length of this encounter, but never, I think, by anyone who has had experience of a Polecat's strength and has seen a Polecat enraged.

The Polecat is a much more stoutly built animal than the Stoat; from nose-tip to tail-end he often measures over two feet, and his tail is by no means a long one, though not so short proportionately as a Weasel's. His head and feet are more massive than those of the Ferret, who is held to be a semi-domesticated albino of the same species. When enraged he is positively terrifying. The hair stands stiff on his back, doubling his size, his eyes start from their sockets, and he flings himself at the bars of his prison as though he would tear them to fragments. All the time he screams (a Marten's is the only scream I know more hideous), and all the time he stinks.

It must not be supposed, however, that either Polecat or Stoat is normally evil-smelling. Both have control over their scent-glands, and only make use of them under the influence of ungovernable excitement. The scent lingers for a considerable time, and in the case of captive specimens naturally clings to their cages. I have found, however, that if a transfer from a foul cage to a clean one can be peaceably effected, there will be no perceptible smell about the fresh quarters; and that, given proper facilities, either Polecat or Stoat will keep himself as clean and sweet as a cat.

Despite the terrifying appearance which a Polecat *can* present, he is, when at his

ease, a singularly handsome animal. His fur, like that of all mustelines, consists of a short woolly undergrowth in which is implanted an outgrowth of coarse stout hairs. These two growths are strongly differentiated in the Polecat owing to their contrasted colours, the undergrowth or pelt being a pale buff, and the outgrowth a dark purple-brown which deepens into black on the throat, limbs, and under part of the body. The tail is well haired but has no pronounced tuft. With every movement of the muscles the buff pelt reveals itself, so that on some occasions, as may be seen from the illustration on page 391, a Polecat appears to be definitely striped, while on other occasions he appears to be piebald. His head presents a bold and striking colouration. Round his lips and the borders of his ears the fur is white; there is a broad band of buff between each eye and ear, which reaches to his cheeks; a narrower, somewhat darker, band stretches across his forehead; and the rest of his head is deep purple-brown, darkening to black on the throat.

It has been suggested that the bold colouring of the Skunk (young specimens appear to be black with white dorsal stripes and a bushy white tail) is an example of "warning colouration"—a proclamation to all whom it may concern that the owner had best be left alone. If this be so, one can hardly avoid crediting Nature with a similar intention in the case of the Polecat. His head is remarkably conspicuous, and, as I have explained, in movement he often presents the appearance of being boldly striped.

It is impossible to define the present distribution of the Polecat. He is a good swimmer, a good climber (Charles St. John gives an instance of one attacking a pigeon's nest on a level with his dressing-room window), and, like all mustelines, an intrepid traveller. It may well happen that successive breeding seasons may find the same Polecats in widely separated districts, but the hand of man is everywhere against him as a murderer of poultry as well as of game, and his best chance is where man is not, and where birds are many. I can fancy no better retreat for a Polecat than the Essex marshes, and I have been interested to receive recent news of him from that district. A few years back I had no difficulty in procuring live specimens from the Fen Country, and, generally, I incline to the opinion that he prefers low-lying ground, though the presence of rabbits or game may of course attract him anywhere. His method of attacking the former is to leap on their backs and worry at the jugular vein, swinging himself like a whip-lash from side to side of his victim's body. Weasels and Stoats act in a similar way. The single paralysing bite into the brain is, in my judgment, purely fortuitous, though no doubt it happens frequently enough.

Attempts to train the Polecat as a ratter seem generally to have failed. Mr. J. L. Bevir, who tried the experiment, writes: "If he could get down the hole he was very efficacious; but if he could not he became angry, and I can see him now pursuing the gardener round the greenhouse."*

If the reader will refer for a moment to the quotation at the head of this article, he will realise, if indeed he did not do so to begin with, that Venator was merely a "sportsman." No fewer than four out of his string of vermin are specifically identical. It is not unlikely that the naturalist of three hundred years hence will regard the modern classification of Martens with similar amusement. The differences between the European Pine and Beech Martens, the American Pine Marten, the Indian Marten, the American Sable, and the Asiatic Sable are so slight that it seems improbable that their specific distinction will be permanently maintained. The fur of all being valuable, and that of the Sables extremely so, it is obviously to the interests of the furrier to maintain, even to create, as many names as possible. Nor can one reasonably blame him, for in colour, gloss, and feel there is a wide difference between the fur of the Sable on the one hand and that of the Beech or Stone (? stone-coloured) Marten on the other, and the value of Martens' fur depends on its approximation to Sable quality.

For the purpose of the present article we need only concern ourselves with

* *Field Naturalist's Quarterly*, Feb., 1903.

CHARACTERISTIC ATTITUDES OF THE MARTEN.

(1) the Pine Marten (Pine Weasel, Yellow-breasted Marten) and (2) the Beech Marten (Common Marten, Stone Marten, White-breasted Marten). It may be said at once, and without fear of contradiction from anyone who has seen the animals alive, that they exhibit marked differences in the external contours of their heads. The Pine Marten type has the longer muzzle and the larger ears. Generally he has the darker colouration, and in most instances a yellow rather than a white front. The colour distinction is of small moment, but the facial distinction has something behind it, for naturalists seem to be generally agreed that in the skull proportions there are marked differences between the two types, and in the dentition slight but constant differences. Their separation into distinct species is therefore a matter on which opinions may reasonably be divided. A question which has excited considerable controversy is whether both types (or species) are, or ever have been, indigenous to this country. There seems to be little doubt that, whatever the previous distribution may have been, it is the Pine Marten type alone which has survived; and all recent Natural Histories follow Alston in declaring that the Beech Marten type never existed in this country at all. I cannot help thinking that the weight of evidence afforded by the older writers tells strongly against this view. All of them, from Pennant to Bell, appear to have regarded the Pine Marten and Beech Marten as separate species, and to have been familiar with both, but most familiar with the Beech or "Common" Marten. Buffon, who was evidently quite well acquainted with the latter, states that in France "this animal is as frequent as the Pine Weasel is rare," and that "the Pine Weasel does not exist in Britain because they have no extensive forests in that country." Bingley, writing of the Beech Marten, says: "Not very uncommon in some of the southern parts of Great Britain and Ireland. It inhabits woods in the neighbourhood of villages and farmyards — in Wales it resides also among rocks." Of the Pine Marten he says: "Pine Martens are sometimes, though rarely, observed in the woody and thinly inhabited districts of Wales and Scotland, and in two or three of the northern counties of England." We need only add Ireland to make the above description strictly applicable to the Pine Marten's present-day distribution.

Photograph by the Rev. A. Bertram Hutton.

SITE OF A MARTEN'S BREEDING QUARTERS IN THE CUMBERLAND FELLS.

A buzzard's nest, with a south aspect, situated on a pinnacle of rock overlooking Little Langdale.

Bingley mentions in addition the use of the Beech Marten in the training of young foxhounds, and quotes from Daniels' "Rural Sports" an instance of one kept as a pet in the kitchen of the "Bald-faced Stag" in Epping Forest. In the face of evidence of this kind it seems hazardous to assert that the Beech Marten

THE MARTEN.
Showing the manner in which it moves along a bough.

type never existed in a wild state in this country, though unfortunately there can be no doubt that it is non-existent at the present moment.

Martens form a connecting link both in size and appearance between the bear-like Wolverene or Glutton, whose remains occur in superficial British deposits, and the true Weasels.

Comparing them with the latter, we find their bodies shorter and stouter in proportion to their limbs, their heads less massive, their noses longer and more pointed. In most aspects the projection of their muzzles conceals their mouths, and, in consequence of this, they exhibit none of that peevish expression which is characteristic of Weasels, and which must be attributed to the droop at the corners of their tightly compressed lips. The eyes of Martens are somewhat lack-

lustrous in daylight, and this may be due to a structural peculiarity which causes them, under certain other conditions, literally to blaze. I remember on one occasion looking into one of my Martens' cages and being staggered by the animal's extraordinary appearance. His eyes seemed twice their normal size and shone like burnished copper. I thought that something was wrong with him, but, on entering the cage and examining him closely, found him apparently quite comfortable and his eyes in their normal condition. Thinking that my own eyes had been at fault, I paid no further attention to the matter until, looking at him a few days afterwards, I observed the same extraordinary effect. This time I happened to move my head slightly to one side, and it then dawned on me that the sun was low at my back and that my own eyes must be near the apex-points of two cones of light reflected from the animal's eyes. The fact that the eyes of certain animals, notably beasts of prey, "blaze like coals" in the dark has often been observed and commented on, usually in connection with animals prowling round a camp-fire. On this

occasion, however, although the sun was low, the whole cage was strongly illuminated, and it occurred to me that if the effect was extraordinary by daylight it would be still more extraordinary after dark, when the source of illumination could be controlled. I accordingly experimented after dark with a bicycle lamp, and found that the reflex was even more brilliant, and that with a suitable adjustment of the lamp the animal's eyes appeared as two round discs of brilliant metallic green. Most of my readers have probably at one time or another caught the glint of a cat's eyes in the dark, and found the effect of it under favourable conditions somewhat uncanny, but neither in the case of the cat nor in that of any other carnivore which has passed through my hands have I found the reflection comparable in brilliancy to that exhibited by the Marten. The explanation of it, which is indisputable, is that the light is reflected from the *tapetum cellulosum*, a layer of cells with a metallic lustre which forms a portion of the choroid and is especially marked in the Carnivora. It is obvious that the full effect can only be experienced when the animal's eyes are widely dilated, and it seems not unlikely that an investigation of the Marten's *tapetum cellulosum* might furnish some explanation of the power which certain animals undoubtedly possess of "seeing in the dark."

From my experience of captive Martens I should judge that they are extremely long-sighted, and that their arboreal habits have been developed in the quest of some lofty look-out. It seems that in the wild, mountainous portions of this country, in which they still maintain a precarious existence, they prefer the high ground for their lairs and breeding quarters, while they descend to the valleys in quest of food, possibly of food sighted from a considerable distance. All the captive Martens of which I have had experience preferred to sleep as high as possible.

The Marten which, as I have already explained, I released by reason of his uncertain temper, at first returned to his cage nightly for food, but presently took up his quarters in a stable-loft and subsisted for a time on fan-tailed pigeons. On several occasions I was able to watch him stalking by moonlight, and in the tactics which he then adopted I found the solution of a characteristic movement which had often puzzled me. This movement consists of a slow wriggle during which the animal is so closely welded to his support, that, while his limbs embrace it, his body actually overlaps it. He progressed thus two or three feet at a time, and in a dim light it needed very careful watching to distinguish him from his bough, or from the ridge of the roof, as the case might be. He could usually get within a couple of yards of the pigeons before he sprang. Sometimes he missed, and it was amusing then to see him stand up to his full height (further precaution being superfluous) and lash his tail with annoyance. If he secured his pigeon he would carry it off at a great pace, never descending to the ground, but leaping from roof to roof and from wall to wall with the same easy grace which he displayed when unencumbered. He usually emerged about half an hour after sunset and commenced his night by a very cautious survey of his surroundings. The slightest movement within a radius of thirty to forty yards would instantly send him back to cover, and he would sometimes be ten minutes in satisfying himself that all was well. After he had disposed of six fan-tailed pigeons (which took him about a fortnight) he transferred his attentions to a neighbour's stock, and for a month I lost sight of him altogether. He turned up again, however, and signalised his reappearance by climbing a Scotch fir some sixty feet in height and regaling himself with a nest of ring-doves at the top. This feat did credit both to his keen-sightedness and to his agility, for the trunk rose sheer for twenty feet without a projecting bough. Once only did I meet him on the ground, and then he had a rat in his mouth, which he promptly took up a lime-tree. Before leaving him I must mention his vocal powers. When enraged his scream was blood-curdling, and only ceased when the object of his aversion withdrew. He had two other notes—one a low growl which he uttered when mumbling his food, and the other a rather agreeable bleat which can best

be compared with the voice of a young kid.

I have already stated that the distribution of the Marten in Great Britain seems to have altered little since Bingley's time. So far as Ireland is concerned, it is cheering to read the following note by Major Barrett-Hamilton: "No doubt the Marten is *now* driven out from the east and south, but it is only of late years that this has been the case, and I contend that even in the more highly cultivated parts of the eastern counties of Ireland it would be an impossibility to name a county in which the animal has not occurred recently."* As regards Great Britain, however, all recent records seem to come from such sparsely inhabited and mountainous districts as the Scotch deer-forest area, the wilder portions of Wales, and the Cumberland Fells. For the following notes on a recent occurrence of a family of Martens in the latter locality I am greatly indebted to the Rev. A. Bertram Hutton, who has also kindly allowed me to reproduce his interesting photograph of a Marten's breeding quarters.

Photograph by the Rev. A. Bertram Hutton.

THE THREE DEAD MARTEN CUBS TAKEN FROM THE NEST SHOWN ON p. 396.

It appears that in May, 1905, in the Tilberthwaite district, a quarryman named Kendall climbed up from the valley, accompanied by his two lurchers, and came to a large pinnacle of rock, on a ledge of which he could see an old buzzard's nest shadowed by a holly-tree which grew from a cleft below it. The dogs showed excitement, and Kendall, who was apparently well acquainted with Martens and recognised traces of them, succeeded in getting the smaller lurcher up to the nest. He himself was, unfortunately, too late to save the lives of three Marten cubs, all of which the dog injured fatally. On the following day, a Saturday, Kendall left work at noon, and took his dogs to the buzzard's nest once more. This time he put up the female Marten, and there ensued a chase which lasted until nightfall, and which ended in the capture of the Marten alive and uninjured. A glimpse of the primeval, this: the huntsman alone and afoot; the pack two lurcher dogs; the quarry worth the hunting.

The Marten ran uphill. Twice she took cover in "burrens" (collections of split-off boulders), and once she doubled. At the commencement of the run she entered a larch wood with the dogs close behind her, but she appears to have preferred to trust to her own speed and her knowledge of the rocks rather than to risk being treed. She easily outdistanced the dogs, who, however, managed to hunt her by scent and to hold her when she took cover. The first time that this occurred she broke away while Kendall was dislodging the boulders. Finally she went to earth in a shallow burrow (probably a fox's) beneath another rock pile, and here Kendall, after an hour's hard work, managed to secure her, using badger screw-tongs and a sack for the purpose. (Screw-tongs were recently the

* *Proceedings of the Royal Irish Academy*, 1894.

subject of an acrimonious newspaper correspondence, and it should perhaps be pointed out that they are not screwed into the animal, but entangled in the animal's fur.) The hunt lasted for nearly six hours, over a distance of about three miles in very rough country. To complete the record it is only necessary to add that a dog Marten had been trapped in the neighbourhood a short time previously.

DOUGLAS ENGLISH.

HOW TO KNOW THE BIRDS

By the REV. MAURICE C. H. BIRD, M.A., M.B.O.U.

THE WADERS—I

LEAVING the Rasorial, or Scratching birds, we now come to the fifth and large order of Waders, of which the Common Plover or Peewit is perhaps the best known representative. In the whole order the feet are long and slender; in the Plover family the toes are comparatively short, and the hind toe is either wanting or rudimentary.

With white under parts, metallic black-green back, wide square tail, white tipped with black, and elongated tapering crest, the Peewit is as well known an object on the poulterer's stall in winter, as its pyriform brown and black blotched eggs are well-known delicacies much sought after by moorland rustics and city epicures. While it is certainly decreasing as a resident, large flocks of this most useful bird to agriculturists still come to winter with us. Their plaintive note betrays both their presence and their species. The peculiar fanning noise made by their large rounded wings when in flight is equally distinctive, and when once recognised will more readily serve for identification purposes than the call-note, for in the non-breeding season their cries are much curtailed.

In the neighbourhood of marshlands and mudflats, when these birds feed on the upland by day, the waterside is resorted to in the evening for the purpose of cleaning their beaks and feet—fouled by worm and slug hunting amongst the clods. Their journeys to and fro are frequently intercepted by the twilight flight-shooter, to whom, however, they offer a very uncertain mark, for they somersault swiftly, and rapidly double back directly they perceive danger below.

Golden Plover are not uncommon in our markets during the winter. In shape, make and habits they resemble the Green or Common Plover, but their upper plumage is grey, thickly bespotted with yellow, and they have no crest. Their legs are black instead of dull flesh-colour. Their call-note—"lou-ee, lou-ee"—is very clear and far-reaching, and their flight is very rapid.

The Grey Plover, though strictly a shore bird, may easily be confounded with the more frequent and highly prized golden species. The two, however, may readily be distinguished if it be remembered that the more common bird has no hind toe, whilst the Grey species has, and that the axillary feathers of the former are white, whilst they are barred in the latter. The Grey Plover is slightly the larger, the eyes are more conspicuous, and the grey and black markings on the back are more striking than the pale gold spangling of the other bird. In spring the white breasts of both species gradually become jet black.

Upon our sandy sea-shores some few pairs of the Ringed Plover, or Ring Dotterel, still remain to breed. In the autumn their numbers are augmented by foreign visitors, small black and white birds with yellow legs and beak. These must not be confounded with the

smaller and far scarcer black-legged Kentish Plover, which much resembles them, though it lacks their perfect black collar; nor with the larger, but equally rare, Moorland Dotterel, with black and white banded chestnut breast and belly—little trips of this bird used regularly to visit our eastern coastline five-and-twenty years ago at turnip-sowing time, and old books allude to them as the "foolish Dotterel"—the tamest of all the Plover tribe.

A much larger and ubiquitous shore bird is the black and white Oyster Catcher or Sea Pie, a strikingly handsome bird with long, straight, orange bill and pale pink legs, which loves the vicinity of limpet-clad rocks, or mussel banks, where the receding tide leaves bare a large extent of foreshore. In flight its pied plumage is strikingly displayed as it skims the surface of the water—not in "lumps" as the manner of most shore birds is, but in large or small linear parties, which follow the leader at equal distances apart. In the northern counties, where this species most delights to breed, the Oyster Catchers follow the larger rivers far inland, and may sometimes be observed resting on grass or cornfields awaiting the turn of the tide for their feeding grounds to be again exposed.

The Turnstone arrives on our coasts in small trips during August, and is perhaps the most attractively coloured, in adult dress, of all our British shore birds, and at once attracts the attention of the coast-frequenting naturalist. It is about nine inches in length, black and chestnut colour above, with black breast, white belly and rump, the crown of the head reddish white with longitudinal black markings, black beak and orange-coloured feet. Like the Grey Plover, it runs quickly, and is difficult of approach, for it is always on the alert, in spite of its being constantly employed in turning over stones, seaweed, shells, or high-water mark *débris* in search of sandhoppers and such small fry.

The Plovers may be known from the Sandpipers by their rounder heads and shorter beaks, and by their having

Photograph by F. T. Newman, Berkhampstead.
YOUNG PLOVER.

but three toes. The Sanderling may be taken as the connecting link between the two families. It has no hind toe, the legs and beak are black, and the beak is short compared with that of the Sandpipers, and straight. It is a regular visitor in spring and autumn, while a few remain for the winter. In general appearance it looks very much like a very light-coloured Dunlin, the commonest of our smaller shore birds, a large flock of which, turning and wheeling in the sunlight, appears at one moment as a dark, and the next moment as a silvery white, cloud, as they suddenly and simultaneously present either the upper or under surface of their bodies to view. In adult summer plumage the two birds differ greatly; the Dunlin, which remains to breed in our moorland and mountainous districts, has then rich chestnut markings on the back, and a

broad black band across the breast, whilst the Sanderling, though reddish brown above in spring, has then only a rufous and black spotted breast. The black beak of the Dunlin is longer than that of the Sanderling, and has a slight down-

Photograph by C. Reid, Wishaw, N.B.

HERON.

ward curve. Both these birds are about eight inches long.

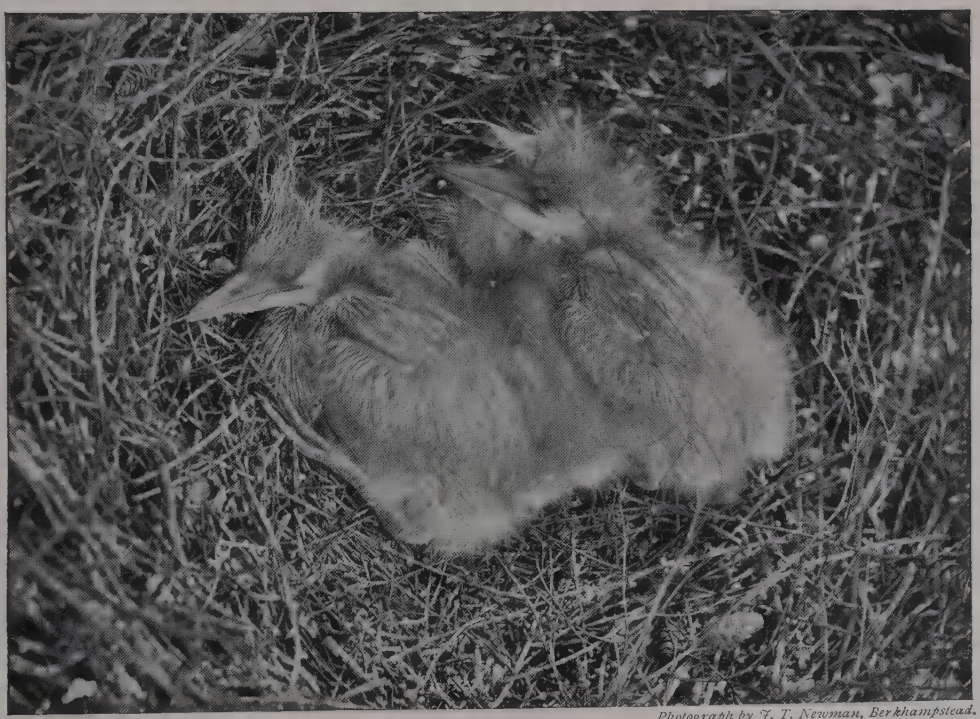
A similar bird in size to these two, and one which at first sight might be mistaken for either of them, is the Curlew Sandpiper, a regular autumn migrant. It has, however, a much more decidedly down-curved beak than the Dunlin, and may also be distinguished from both it and the Sanderling by its white rump and longer legs. In summer the breast feathers of the Curlew Sandpiper change from white to chestnut, as is also the case with the Knot, another fairly common spring and autumn visitor, but an altogether lumpier bird, more like a Plover in build, and with a comparatively short beak. It is one of the tamest of shore birds, and allows almost as near an approach as will the Dunlin or Ringed Plover. A curious seasonal change in this bird is that the yellowish green feet and legs, and yellow soles, which young and adult wear in winter, become black in summer.

The little Stint, the smallest British shore bird—it is only six inches in length—is like a diminutive Dunlin, but it has the beak quite straight. The Purple Sandpiper, more solitary in its habits and perhaps less common than any yet mentioned, may be distinguished at all seasons by the shortness of its dull yellow legs, and the darkness of the feathers above the tail.

A tidal harbour, at ebb and flow of tide during September and May, is the best place to watch the various Waders, but a vigilant eye should be kept upon the last piece of sand, mud, or shingle to be

Photograph by J. T. Newman, Berkhampstead.

OYSTER CATCHERS ON AN INLAND LAWN.



Photograph by J. T. Newman, Berkhampstead.

YOUNG HERONS.

covered by the incoming water, and to be exposed by the falling tide.

Even the great, gaunt Heron is tempted in the early morning and evening hours to haunt harbours and estuaries adjacent to towns, in quest of the sea-going eels, which in the autumn months quit fresh water for the purpose of spawning in the sea. Knee-deep and motionless will the grey-bodied, black-winged Heron stand for hours, silently and patiently waiting to dart his powerful and pointed beak with unerring aim at the passing fish—the species is not material, for the bird is not particular. As they are too long to be neatly gathered up, in the manner of most birds, beneath his comparatively small body, "Frank" carries his lanky legs stretched straight out behind him as he flies, utilising them partly to compensate for his somewhat stumpy tail (a longer one would be in the way whilst wading) as steering gear, and as a compensating balance to his gracefully elongated neck. If seen at close quarters, notice should be taken of the Heron's tapering, back-directed crest and handsome black and white neck plume. Should you chance to handle a dead Heron—a living one would be both difficult and dangerous—turn back the body feathers, and observe the powder-down patches, and the pectinated toe-nail. If you can discover the true use and purpose of these singular structures—though neither is peculiar to the Heron—you will have made a name for yourself in ornithology! As leisurely, or even lazily, as the Heron seems to fly, it has been calculated to make from 120 to 150 downward flaps per minute, and to progress at the rate of thirty miles an hour.

MAURICE C. H. BIRD.

Photograph by J. T. Newman, Berkhamps'ead.

A HALF-GROWN HERON.

STORMY WEATHER.

From the Water-Colour Drawing by Leopold Rivers in the National Gallery of British Art.

VALLEYS, AND HOW THEY ARE FORMED

By J. LOMAS, F.G.S., A.R.C.S.

WHEN man is confronted with some of the most sublime and awe-inspiring scenes which the earth affords he is apt to lose the sense of proportion. He lacks a scale with which to measure them. Time is the factor he is mostly prone to under-estimate, and in seeking to encompass the events within circumscribed limits he is compelled to exaggerate the importance of other factors, or he has recourse to extraordinary causes differing from the activities at work at the present day.

"IN THEIR TYPICAL FORMS VALLEYS ARE V-SHAPED."
Scoredale, Westmoreland.

It seems to be inherent in the nature of man that no sooner does he see a phenomenon than he seeks to explain it. The fear of the unknown is always with him, and if the ordinary occurrences about him do not satisfy he invokes more violent means. A century ago cataclysms and revolutions were accepted as a matter of course, and were called in to explain events which are now attributed to very ordinary causes.

In the early days of the nineteenth century the great French *savant*, Baron Cuvier, voicing the opinions prevalent in his day, wrote, "It is in vain to seek amidst the forces now acting on the surface of the earth for causes sufficiently powerful to produce the revolutions and catastrophies of which its exterior bears traces; and if we have recourse to the external causes at present in action, we shall not find them adapted for the purpose."

Echoes of these ancient beliefs are still heard from those who have not carefully studied the effects of existing agencies; but while it would be unwise to say that the forces have never varied in intensity or in kind, we seldom find it necessary to assume exceptional conditions. These thoughts naturally arise when we come to consider the origin and forms of valleys. Take, for instance,

the wonderful zigzag gorge of the Zambesi below the Victoria Falls, where the river courses between two vertical walls of rock over 400 feet in height.

It is difficult to convince the casual observer that this mighty chasm has not been riven asunder by some convulsion of Nature, and yet when it is followed down stream for some miles the slopes begin to recede, and finally take the form of an ordinary stream valley. This only means that the banks of the lower part of the river have been subject to erosive influences for a longer time than those nearer the Falls. Hence it is impossible that the whole can represent a gigantic rupture such as is popularly supposed to have taken place.

Ordinary stream valleys present just such features, although of differing magnitudes—*i.e.* they are narrow and gorge-like near their origins, widen gradually down stream, and finally merge into the outlines of the plain.

Thus in their typical forms valleys of this nature are V-shaped when viewed from above, and it is only when special conditions intervene that they depart from the type.

Again, if taken in vertical section the same V-shaped outlines should predominate. The broad open V of the lower part once had the narrower, steeper section we see in the middle portion of the valley, and this in turn was, in former times, a gorge like that existing near the source. So we can appropriately speak of these different parts as young, mature, and old. Sometimes the V is not symmetrical, but shows a long limb and a short limb. Such a form results when the beds are inclined, or dip away from the horizontal The longer limb usually follows a hard band of rock which the stream has encountered during excavation.

In our studies of rivers we found that they seldom keep a straight course but meander in curves, the sizes of which bear a definite relation to the volume of

Photograph by G. Bingley, Headingley.

"THE BROAD OPEN V OF THE LOWER PART ONCE HAD THE NARROWER, STEEPER SECTION OF THE MIDDLE PORTION OF THE VALLEY."

High Cup Nick.

water contained in the stream. So in excavating valleys, rivers wear away the banks on alternate sides and give rise to inosculating spurs.

In the northern parts of our islands we seldom meet with typical valleys of this kind. Their outlines have been modified by events—not far distant, geologically speaking — when glaciers, nursed and fed by the snows which fell on the high grounds of North Wales, the Lake District and Scotland, moved slowly down into the plains. These glaciers grew to such enormous dimensions that the Irish Sea was completely filled, and the ice welled over into the Midlands. Ice from Scandinavia, too, crossed the shallow North Sea, and not only infringed on the eastern coasts but travelled for many miles into the interior, even as far as Finchley, near London.

Photograph by Tomkinson, Liverpool.

"SOMETIMES THE V IS NOT SYMMETRICAL."

In contrasting the erosive effects of river and glacier we note that a current of water confines its action to the lowest part of the valley through which it flows; and unless exceptionally hard rocks intervene, the sides run with an even slope from the crest to the place where the cutting is in progress.

"IN EXCAVATING VALLEYS RIVERS WEAR AWAY THE BANKS ON ALTERNATE SIDES AND GIVE RISE TO INOSCULATING SPURS."
Church Stretton.

In any case the general effect resolves itself into the characteristic V section mentioned above.

On the other hand, a glacier does not confine its activities to a narrow,

A U-SHAPED VALLEY WHICH OWES ITS FORM TO GLACIAL ACTION.
Glencoe Pass.

Photograph by M'Isaac & Riddle, Oban.

sinuous, ribbon-like notch where the banks converge, but covers the floor of the valley and rasps the sides as well. This results in a form which is U-shaped in section.

But the glacial period was only an episode in the history of the valleys.

DIAGRAMMATIC SECTION OF A GLACIER-FORMED VALLEY.

Long before the ice gathered on the hills rivers had been at work and had left the distinctive marks of fluviatile action.

In many instances the ice has not obliterated the earlier forms, but has carved out a U-shaped valley in the lower part of an older river valley.

Thus we have presented to us a valley within a valley—the higher slopes gentle and converging to a V if continued, the lower part precipitous and in section like a U. At the junction of the two slopes there is a sudden steepening, and streams entering from lateral valleys usually enter the main river as waterfalls. In unglaciated regions the tributaries invariably join the trunk rivers at an accordant level.

The inosculating spurs of typical river valleys are also modified; they become blunted and steep instead of grading themselves to the floor of the valley, and sometimes they are entirely removed by glacial action.

Now let us consider the case of a well-established river, with lateral valleys through which tributary streams flow in a normal and well-graded course.

The overdeepening caused by glacial action would disturb the accordance at the point of confluence, and removing the lower part of the banks, the lateral valleys would be left hanging on the slopes. Hanging valleys having this origin are very common in Switzerland, and many examples can be seen in North Wales and in Cumberland.

Thus U-shaped valleys, blunted spurs and hanging valleys are regarded by many geologists as the work of glaciers, and this view is strengthened by the fact that they only occur in places where signs of glaciation are apparent. Another type of valley of a very exceptional and puzzling character is met with in the glaciated parts of our islands.

They show evident signs of having been excavated by running water, and yet they are streamless. They are so situated as to preclude the possibility of the present system of drainage having taken any part in their formation. We know from recent investigation that they belong to the period when ice advanced over the land and obstructed the pre-glacial drainage. Finding their natural outlets to the sea blocked by

"THUS WE HAVE A VALLEY WITHIN A VALLEY."
Lakes in Val Piora, above Airolo.

the invading ice the waters were impounded as lakes, and thence they escaped across the lower notches of the hills and along devious channels to those parts of the country free from ice. On the retreat of the ice the drainage reverted, in the main part, to its original system, and the valleys were left dry and functionless.

So far we have only dealt with valleys of erosion carved out of mountain masses by river, glacier, frost and other agents acting from without.

But there are other forces acting from within, and their function is to crumple the earth's crust into folds with crests and hollows like the waves of the sea. In the upraised portions the rocks are arched into anticlines, and the strata dip from the crests into the troughs. In the complementary hollows the beds bend into synclines or loops like a hanging chain. We should naturally expect that the arched portions of the folds would exist as mountains, and the synclines as valleys. In the newer mountains and valleys, such as the Jura mountains, and in the valley of the Thames from Reading to the sea, this is the case. But, strange to say, the reverse is seen in the majority of mountains and valleys. The synclines form the highest peaks, and the valleys have an anticlinal structure. A little consideration will show that this is exactly what should happen under normal conditions.

If we take a bar of india-rubber exactly a foot long and bend it into an arch, we discover on measuring that the convex side has extended to more than a foot in length, and the concave side is less than a foot. This means that in the outer curve the particles have become stretched and are in a state of tension, while the particles of the inner curve have become more closely packed together.

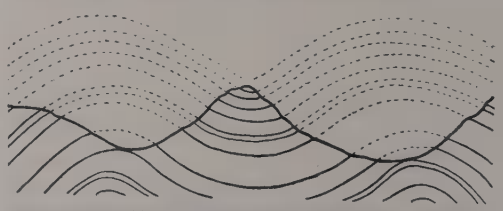
Photograph by G. Bingley, Headingley.

"THE LATERAL VALLEYS WOULD BE LEFT HANGING ON THE SLOPES."

Looking up the Pennant Valley, N. Wales. (Hanging Valley marked with an arrow.)

Applying this to folded rocks less able to accommodate their particles under stress and strain, we find that in anticlines there is a tendency for the strata to crack and produce open joints, while in the synclines they become more compact.

Thus the fractured and distorted anticlines readily yield to disintegrating agents, while the more solid and compact synclines are better able to resist them.



DIAGRAMMATIC SECTION THROUGH STRATA WHICH HAVE BEEN FOLDED AND CARVED INTO MOUNTAIN AND VALLEY.

In course of time the crests become reduced to the level of the hollows, and the lines of wasting being firmly established, the action may continue until the former valleys stand up as hills and the mountains have become valleys.

Pass of Llanberis, N. Wales.

Photograph by G. Bingley, Headingley.

Photograph by G. Bingley, Headingley.

"IN MANY INSTANCES THE ICE . . . HAS CARVED OUT A U-SHAPED VALLEY IN THE LOWER PART OF AN OLDER RIVER VALLEY."

Pass of Nant Ffrancon, N. Wales.

GLACIER-FORMED VALLEYS.

The diagram on page 410 shows a generalised section through strata which have been folded and then carved into mountain and valley by destructive forces.

The broken lines indicate the form of the country as it would exist if folding alone had taken place, and the continuous lines represent the outline after the carving agents have been at work.

It will be noted that in the synclinal hill the beds dip or incline into the interior, and away from the sides, whereas in an anticlinal hill the strata would curve upwards in the interior, and would run parallel with the flanks.

Ruskin, in "Modern Painters," discusses this question very fully, and shows that when the different layers of rock dip towards the middle we get the conditions of maximum strength, whereas when the slope is towards the exterior the slopes are perilous and unstable.

It is essential to the existence of the older mountains that they should have been able to withstand denudation, hence Snowdon and the great majority of our highest mountains are synclinal in structure. They are not valleys which have been exalted, but the mountains which, at one time, towered above them have been made low. In a former article we have seen that there is abundant evidence to show that changes of level have taken place at various points round our shores. In fact, depression is now going on in the neighbourhood of most of our river estuaries. In view of this let us consider the case of a river valley, widening towards the sea, and gradually sinking beneath the waters. The former channel gives place to a broad inlet of the sea, and if sinking continues until the mouths of tributary streams are affected we have V-shaped lateral bays running up into the land from the main inlet.

Thus we must attribute estuaries round our coasts to the work of rivers rather than the erosive power of the sea.

What the sea has done has been to drown pre-existing valleys. The principal ports round our coasts, such as Liverpool, Bristol, Southampton, London, and Hull, all owe their importance to the existence of "drowned valleys" such as we have just described.

J. Lomas.

HOW TO KNOW THE TREES GROWING IN BRITAIN

With Notes, descriptive and photographic, for their Identification in all Seasons of the Year

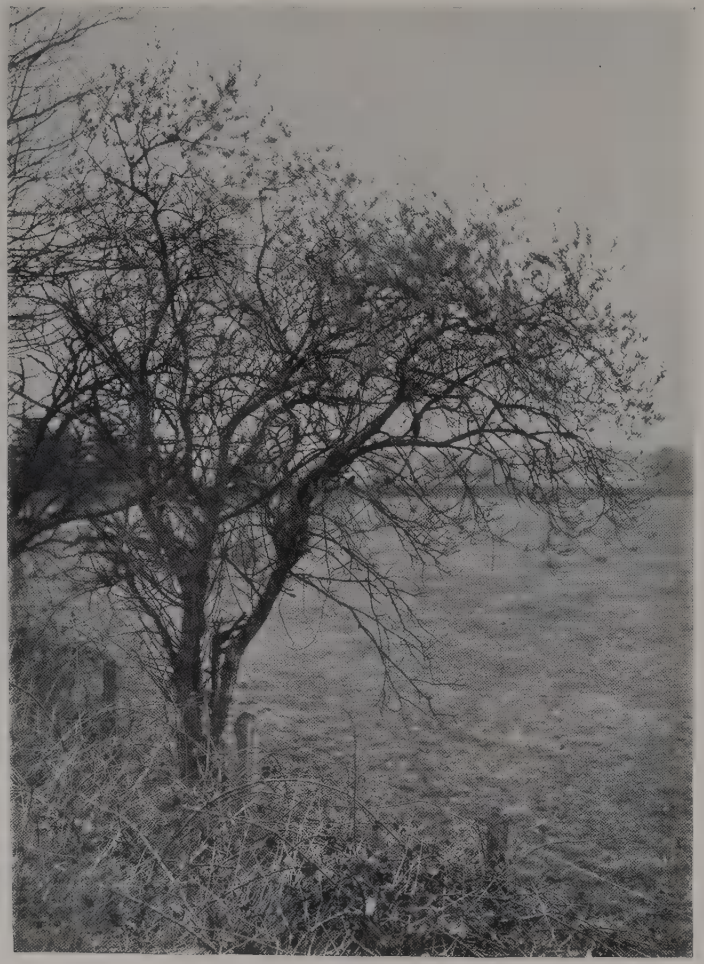
By HENRY IRVING

THE WILLOWS—II

THE GOAT WILLOW, OR SALLOW

THIS, with its allies, the Grey Willow and the Eared Willow, shows considerable variation, from those just described, in twigs, buds, and leaves and in the time of flowering. Though the Sallow may grow into a small tree, it is generally met with as a considerable bush, or as forming part of the hedgerow.

The twigs are shorter and stouter, the buds are more rounded and larger than in the case of other Willows. The catkin buds are especially large and prominent. The leaf-scars are broader. The leaves, generally, are oblong, but sometimes they are rounded. Their upper surface is wrinkled, of a more or less deep green, their lower surface is bluish green.



THE SALLOW IN SPRING.

THE PURPLE OSIER.

In the Grey Willow they are lighter in colour. The leaf tip often takes the form of a funny little projection, to which a decided twist has been given. The leaf margins are slightly scalloped. Stipules are large and persistent, especially so on the Eared Willow. The catkin buds open, showing their silvery silken tips. These are fully matured before the leaves appear. The pollen-bearing catkins are more or less globular in shape, very conspicuous and abundant, arraying the whole tree on which they are borne in a canopy of gold. They have great wealth of pollen, in which the bees luxuriate, and which they collect for bee bread. The fruit-producing catkins, on distinct trees, are more cylindrical in shape, and green to silvery in colour. Both kinds of flower supply abundant nectar. There is no question here as to the agency by which the pollen is chiefly conveyed from tree to tree, from flower to flower. In their season the Sallows hum like a bee-hive, so lavishly is the banquet spread, so gratefully appreciated after the long winter's scarcity. With the flowering of the Sallows the hive's activities fully commence. By about the time the leaves have fully matured the fruiting catkins become masses of fluff, and the Sallow—tree, bush, or hedge—is whitened as though snow had fallen. The cottony seeds are borne by the wind far and wide.

SALLOW TWIG, SHOWING LEAF AND FLOWER BUDS. RESTING BUD (Enlarged).

THE OSIERS

The characteristic growth of the Osiers is that of long slender branches, rising from a stool at the ground level, to form a spreading bush. By natural preference there are only two of our Willows with this habit, the Osier and the Purple Willow. But since the long slender growth of the young shoots of many of the Willows, as seen especially when trees have been freshly pollarded, adapt these trees to this manner of growth under cultivation, they are often so found among the Osiers. This is particularly the case with the White Willow and its varieties, one of which, the Golden Willow, is very noticeable from the rich golden and deep orange colour of its stems and twigs.

The leaves of the Osier are very narrow and long, the margins being almost parallel for some distance, though inclined to be wavy. They are pointed at both ends. They have silky hairs on the under surface, which lie close down, in a direction parallel to the secondary veins. The silky hairs on the leaves of the White Willow, in distinction, are parallel to the midrib. The flower catkins of the Osier appear before the leaves.

The leaves of the Purple Willow are also narrow and moderately long, generally without hairs, or with very few. A distinguishing fact with this Willow is that its buds, and therefore its leaves, show a decided tendency to grow in nearly opposite pairs on the twigs, especially towards the tips, and in this respect it departs from the spiral arrangement adopted by all others of the Willow tribe. The stems deepen in colour to a rich purple, as do the buds also, hence the name given to this Willow. As before stated, the pollen bearing flowers have their two stamens united, but with the full complement of pollen bags. Flowers appear before the leaves.

THE DWARF WILLOWS

These, being Arctic plants, are only found in elevated situations, most of them on the mountains of Scotland, and some on those only of the extreme north, where they find conditions most suitable to their requirements. Their stems usually trail along the ground, rooting as they go, and putting up erect lateral shoots. One of them known as the Least Willow and

as the Herbaceous Willow may be met with on more southern mountains, but above the 2,000 feet line. It has its stems wholly underground, whilst its shoots rise or fifteen inches. Its twigs are usually reddish, or purple-brown in colour. Buds and shoots are silky. The leaves also are covered with silky hairs, though the

THE CREEPING OR SILKY WILLOW.
It barely overtops the Grass.

but an inch or so. The dwarf Willow most likely to be found south of the Tweed, and at a moderate elevation, is the Creeping, or the Silky, Willow. It may be looked for upon moorland where the heather grows. It prefers a sandy soil. In height it grows from six to twelve, upper surface is sometimes without these. In size and shape they are very variable, from half an inch to an inch long, narrow, or more rounded. The margins are very minutely serrated. The flower catkins appear with the leaves. The seeding catkins may be present till late summer.

HENRY IRVING.

WATER RAT ENTERING THE WATER.

HOW TO KNOW THE WILD ANIMALS

By DOUGLAS ENGLISH, B.A., F.R.P.S.
Author of "Wee Tim'rous Beasties," "Beasties Courageous," etc.

THE WATER RAT

THE WATER VOLE

With Photographs by the Author

I HAVE already referred to the difficulties involved in a study of our wild animals, and I have ascribed these difficulties to their small size, their nocturnal habits, and the concealment of their breeding quarters. The Water Rat is, in certain respects, exceptional. He is large enough and common enough to compel observation; he is habitually abroad while it is yet day; and he displays, under favourable conditions, an engaging confidence in man.

Again, the power of making friends with animals is not given to everyone, but it seems to rest on little more than sympathy, and a realisation of the fact that the first overtures must come from the animal. The animal has to overcome an instinctive prejudice, the origin of which must be attributed to human cruelty, and the continuance of which is unfortunately justified. I have sometimes ventured to hope that in the case of many Water Rats who have allowed me to approach them daily, and in the case of one Water Rat in particular who learnt to take food from my hand, I have made some infinitesimal progress on the path to a better understanding.

It would be well, perhaps, at the outset to invite the reader's attention to the specific difference between the subject of

this article and that unfortunate pariah, the Common Brown Rat. The opinion that the latter should be exterminated is one which, in its present popular and somewhat hysterical phase, no naturalist can entertain, but the existence of this opinion renders it necessary to emphasize the distinction between the two animals, lest a clumsy swipe at the one species should involve the destruction of both.

LAND RAT PHOTOGRAPHED AT A RANGE OF ABOUT THREE YARDS.

Their points of resemblance are confined to a rough similarity in size and colour. But for the unfortunate coincidence that the Common Brown Rat is a past master in swimming and diving, and takes naturally to a semi-aquatic existence on the banks of suburban streams, confusion between the two would be scarcely possible.

If the reader will refer to the accompanying photographs, both of which were taken at the "natural" range of about three yards, he will see at a glance the difference in shape of the heads, and if he has read my previous articles, he will recognise this difference as familiar. The Water Rat is a large amphibious Meadow Mouse. His features are blunted, his body thick-set, his eyes beady, his limbs short but stout, his ears hidden in fur. His tail is comparatively long (about two-thirds of the length of his head and body), but its thick hair covering and blunted end serve at once to distinguish it from the naked tapering organ of a True Mouse. In the possession of musk-glands a little forward of his hind legs, and of five pads instead of six on his hind feet, he differs from the Meadow Mouse type which we have already considered.

Like the Water Shrew Mouse, he shows few outward signs of being aquatic. His feet are not webbed. His tail is not compressed. If one examines him closely, one finds that the long stiff hairs which form his outer coat are sufficiently greasy to repel water, that he can close his ears at will, and that there is a secretion of oily matter round his eyes which dries white, and so, by contrast, somewhat heightens their brilliancy. That this secretion performs some useful function may be assumed from its persistence. A captive Water Rat who has no facilities for a plunge bath will be practically blinded by an accumulation of sebaceous matter round his eyes.

WATER RAT PHOTOGRAPHED AT A RANGE OF ABOUT THREE YARDS.

The above characteristics justify the assumption, which observation will confirm, that the Water Rat is a good but not an extraordinary swimmer. The theory has somehow crept into the books that in swimming at his ease he places his fore-limbs against his sides and employs his hind-limbs alone. I cannot confirm this from personal experience. A swim-

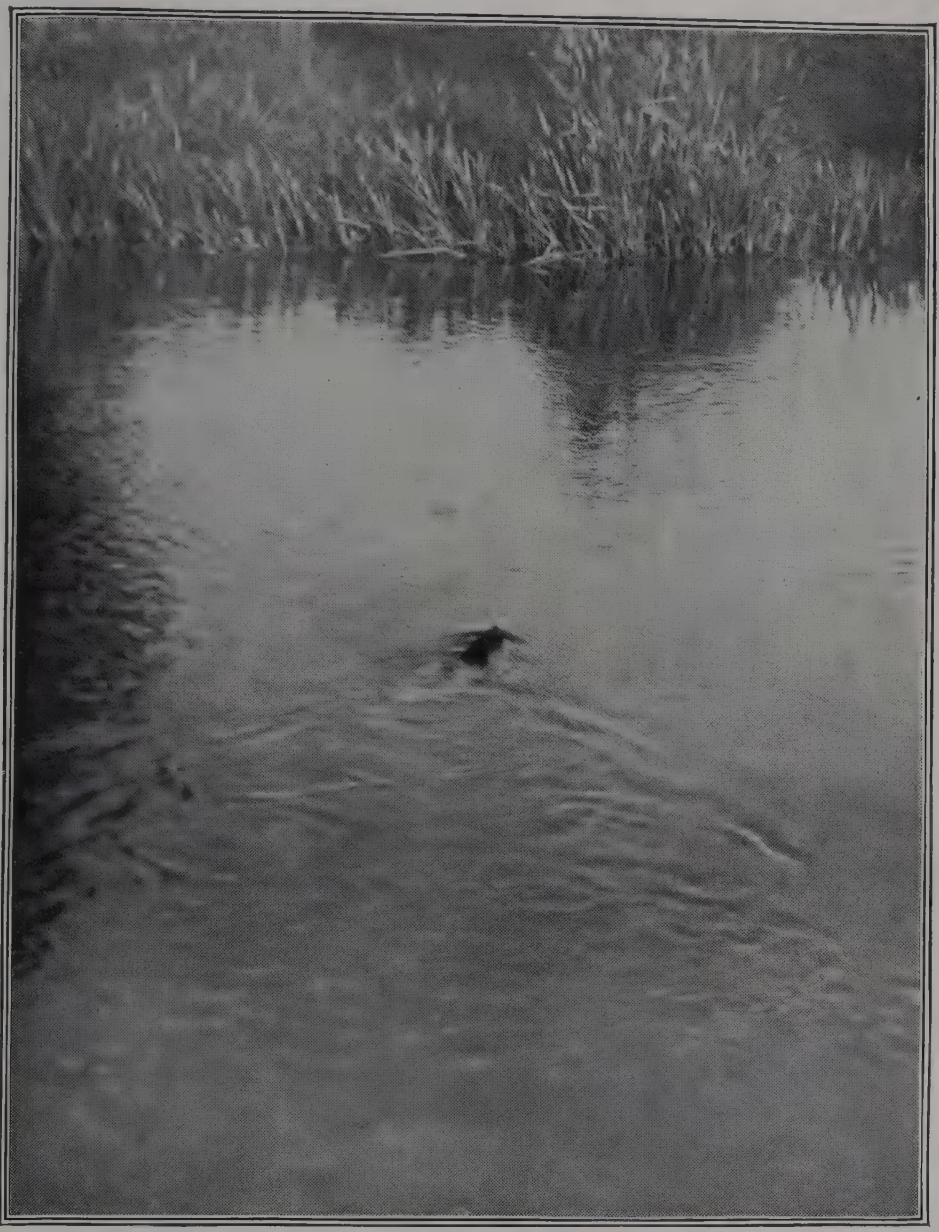
ming quadruped, who dispenses with the use of his fore-limbs, will be found to balance the loss of power in one of two ways. Either he uses his tail as a propeller, in which case one or both pairs of limbs act simply as fins (balancers) with an occasional sweep to help him through a quick turn ; or else he employs his hind-limbs frog-fashion, a method which requires a specialisation of form totally different from that of the Water Rat, and which results in a progression by successive jerks.

WATER RAT.
The white oily deposit round the eyes can be well seen in this picture.

One feature of a Water Rat's swimming is that his tail is functionless ; another is the smoothness of his action. He glides across the surface with his back bone-dry and his sides barely awash. Apart from the twin ripples which spread outwards from his muzzle, there is little disturbance of the water. One can hardly avoid the conclusion that his stroke is a smooth dog's-paddle, during which the alternate movements of his four limbs are in parallel perpendicular planes.

In diving from the surface he arches his back and no doubt strikes with all his feet at once, but the movement is so quickly executed (he seems to drop into a hole) that it is impossible to follow it with certainty. Usually the dive is complicated by a turn, and he reappears, if he reappears at all, in quite a different direction from the one in which he was originally heading. I have written "if he reappears at all" advisedly, for the resighting of a Water Rat who has dived either from the bank or from the surface is a difficult matter.

In connection with this difficulty I experimented at length, some years ago, with Water Rats in a large tank. My chief object was to determine how long a Water Rat naturally remained under water, and how long he *could* remain. The tank was so situated that its interior could be viewed from a distance, and that one could approach to the edge of it noiselessly and unseen. It was tilted to ensure six inches to a foot of water at one end, and a dry nesting place at the other. The bottom was of rough concrete, and the whole interior was open to the sky, so that leaves blew freely into it. The longest time during which any Water Rat remained submerged — I experimented with five —was a minute and a half. The normal time proved to be half a minute. As the Water Rat dived, he invariably turned to right or left, and sometimes completely round. Often his dive was so suddenly determined on that he was unable to expel much air from his lungs, and, since his swimming area was restricted, he was compelled on these occasions to devise some means of keeping himself submerged. This he effected by securing a hold on the bottom with his fore feet, and it not infrequently happened that, while the greater part of him was thus anchored, his feet and tail lay astraddle on the surface. He would remain in this ostrich-like position for a considerable time, evidently unconscious of anything being amiss. When the neces-



WATER RAT SWIMMING ACROSS A RIVER.

sity for a fresh air-supply was forced on him, he shot up to the surface, and, in the absence of any cover, gulped at the air and dived afresh. If there was any cover however (a single leaf was sufficient), he would rise with his nostrils beneath it, and hang slanting and motionless, with his head, and, so far as he knew, the rest of him completely concealed. On several occasions when there was no cover he brought up water-logged leaves from the bottom. Whether this was pure accident, or instinctive cunning, I am unable to say, but of the fact that he used such water-logged leaves as cover I am certain.

From these experiments I drew the following conclusions :—A Water Rat's normal time of submergence is half a minute—five minutes would certainly drown him. A Water Rat's vision under water is good. A Water Rat who dives and fails to reappear either (1) swims under water to some submerged and known hole in the bank, or (2) rises under cover in such a way that he can breathe unseen, or (3) clings to the bottom. In the first case it would be impossible to observe his emergence; in the two other cases it would need an extremely sharp and practised eye to detect it.

A Water Rat who is startled while swimming invariably dives, but a Water Rat ashore often prefers to trust to the protective character of his surroundings, and flattens himself so that he can look upwards and backwards in the direction from which he instinctively suspects danger. The position shows him at his worst, but lends itself to "stroking," if the caress be tactfully offered. For a more worthy conception of his quality one must study his "round" and his "halts." The latter can be determined, at any time, from the tokens of his presence which he leaves behind him. Often they are on spits of mud such as form on the inner curves of streams, often on silted inlets sheltered by over-hanging grass, often at the submerged end of some fallen willow or mass of flotsam.

Evening and morning he visits them, and, given a spot whence one can command a good length of stream, one can count, in fine weather, on being able to observe his progress.

A ripple heralds his coming. Turn your glass towards it and you will probably see no more than a ripple. This means that he is hugging the bank and that the hollow of it conceals him. Presently you catch him heading outwards. He swings sideways to midstream, then seeks the bank again. You lose him altogether now, even the ripple of him. Mark the spot, for later you will find a sheltered run in the reed-bed, and here, if you will, you may trap him. At last he reappears, ten yards from where you lost him. This is where he crosses the river, but, before starting he sits back on his haunches and cleans himself all over. Then he sniffs the air, looks upstream and down, gives himself a little shake, and slips into the water. He heads straight for the opposing bank, but the current catches him, and he lands ten yards below his starting place.

Another little shake and he is dry. You need the glass no longer. For ten minutes the pair of you sit wrapt in a brown study. Presently he remembers the object of his journey, and swims out to the clump of mare's tail. He plays here for five minutes, sometimes scrambling over it, sometimes diving into it. It seems to hold some delicacy—small snails, perhaps, which serve to whet his hunger. He swims back shorewards, makes as though to land, but, at the last moment, changes his purpose, and glides half-floating, half-swimming, down to the second reed-bed. In this he disappears, but the reed-stems bend and creak and flutter, and presently he comes, as you knew he would, to the clearing which directly fronts you. The clearing looks as though some beast had rolled in it. The reeds lie prostrate, here and there lopped short, here and there dragged sideways, here and there entangled.

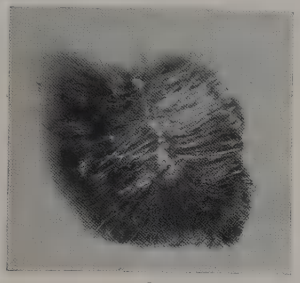
The Rat runs on them carelessly, though at each step the water oozes round him. He knows them well, for he himself felled them. To-night he will fell more. He rears himself on his hind legs and starts to nibble. A reed-stem sways and shivers; presently it falls. Then he starts nibbling lower. His object is to gain the pith. He soon reaches it, and

cuts the length which suits him. Then he swings round to face the stream and you. He sits back on his haunches and holds his portion in his hands. He is a noisy eater—so noisy that while he eats he can hear little but his own munching. If he would listen, he must cease to eat. Now and again he stops—once as a hay cart lumbers on the bridge, once as a swallow sweeps across his nose, once as you sneeze. This last sound seems to scare him. He drops his paws and stares at you; brushes his face and stares at you; sits back once more and stares at you. The current steals his meal away, but he soon gets a second one, which means a second reed-stem felled. Two more and he is satisfied. He creeps into the tangle and you see him no more, but you probably will if you visit the same spot at the same time to-morrow.

It is unlikely that a normal Water Rat confines himself entirely to vegetable food, but it is quite certain that the outcry which has occasionally been raised against him as a destroyer of trout has no weight of scientific evidence to support it. I have known Water Rats to frequent a trout-hatchery adjoining a river without causing any appreciable damage, but I have never known them to frequent the shallow, swift-flowing, gravel-bottomed tributaries which trout at large select for spawning.

Their natural habitat is the slow-running, weed-encumbered, coarse-fish stream; the dyke; the pond; or the mill-head. Their natural food consists of the water weeds, reeds and grasses to be found in such situations. Their structure precludes any likelihood of their being able to pursue, let alone catch, swimming fish. It has been recorded (with evident intent to secure a conviction) that the Water Rat has been trapped in a gin baited with meat, and that he has filched fish which

1



3

4

2

5

1 and 2. The right upper and lower molars of the Water Rat. Prismatic spaces in English reckoning, 5, 4, 4; 7, 5, 3; French reckoning, 5, 4, 5; 7, 5, 5.
3. The musk gland of the Water Rat, the hair being parted to show it.
4. Under surface of a Water Rat's hind foot, showing the five pads.
5. Skull of the Water Rat. The large upper incisors are a rich orange colour, the lower dull yellow.

WATER RAT SLIPPING INTO THE WATER.

improvident anglers have deposited on the bank. Both happenings are likely enough. A Water Rat can be easily trapped in an unconcealed gin baited with nothing—it would hardly be reasonable to conclude from this that he lived on air—and dead animal matter, especially if blood-tainted, will attract any of the Muridæ.

It does not follow that the Muridæ are, as a class, capable of preying on active vertebrates. So far as slow moving invertebrates are concerned, I imagine that the Water Rat will joyfully consume any that he can catch—water-snails, for example, bivalves, larvæ of aquatic insects and small crustaceans. To this extent he may be considered carnivorous. Two competent naturalists, Messrs. Patterson and Latter, suspect him of eating cray-fish. The habits of this crustacean might easily lead him to lie up in the subaquatic entrance to a Water Rat's burrow, in which case he probably *would* be eaten.

An amphibious existence ensures two avenues of escape, but, at the same time, provides two sets of enemies. One seldom encounters immature Water Rats at large, and I am inclined to think that they are kept in the nursery until they are fairly grown. They take to swimming like young ducks.

Besides being an easy prey for carnivorous animals, such as the stoat, weasel and otter, and carnivorous birds, such as the heron and the owl, Water Rats must continually beware of carnivorous fish. Trout, pike and eels probably thin their numbers considerably, and there are several records of these voracious beasts being choked in their attempts to gulp too stout a specimen.

The nest of a Water Rat is generally difficult to discover, though instances of its building in reed-beds are not very infrequent. The breeding-nest is more usually situated at the end of a long tortuous burrow, with at least one subaquatic entrance, and several above the water level. It is of the usual type—a mass of bitten grass and reed-stems, with a rough-wound outer casing. The

A COMBAT BETWEEN WATER RATS.

animal is prolific, and probably has several litters (five being the usual number of young) during the warm months. I have found hairless infants in October. During hard weather Water Rats are not much in evidence, and, I fancy, lie up in their burrows in a semi-torpid condition. They are capable, however, of withstanding very severe cold.

During one hard winter the six-inch depth of water in the tank to which I have already referred was frozen solid for several days. I provided my Water Rats with hay to make a nest of, but they preferred to warm themselves by feeding and exercise. When the thaw came they constructed a burrow out of the hay. In the first place they wetted it completely, and then they made a nest, or rather a succession of nests (for the experiment was repeated), each with one outlet perpendicularly upwards, no doubt for ventilation, and one beneath the surface of the water.

On the whole the Water Rat may be considered harmless, and the good work which he does in keeping down the growth of water weeds should justify his being protected.

In the old days, when water power was largely employed in the manufacture of black powder, his presence in a factory was by no means desirable. He tunnelled into the artificial banks which were designed to ensure a good head of water, and he attacked the plantations of willow and osier destined for charcoal. Even now his burrows may cause trouble to the miller, but against this should be set his services in keeping the water channels clear.

Plagues of Water Rats are not unknown, but are not so frequently experienced as plagues of Meadow Mice. The most recent instance in this country occurred in the estuary of the Humber in 1896, and the following extract from the *Eastern Morning News* of February 10th, 1896, gives an excellent idea of its character :—" The Humber Conservancy Commissioners have not yet solved the difficult problem of how to rid Reed's Island of the plague of rats that now infest it, nor are they—the most ready means, the flooding of the island, having failed—likely to do so in a hurry. What a few years ago was a splendid pasture land, and sustained thousands of sheep in its fresh verdure, is now the home of myriads of rats. It is burrowed from end to end, and so densely populated is this habitat of the rodent, that it is said that it is almost impossible to put your foot down without standing upon a rat hole. It is only about a year ago that the rats got the upper hand, and the

A DARK SPECIMEN OF THE WATER RAT.
Melanism is extremely common in the species, and the tail not infrequently has a white tip.

Commissioners of late have been very much exercised as to the eviction of their unwelcome tenants. It was decided to cut openings in the banks which surround the island, and thus let in the Humber waters at spring tide, with a view to drowning master rat and his numerous family. The openings having been made at considerable expense, the water was let in a week ago last night, but not with the result anticipated. As the water advanced the rats fled from their holes in tens and hundreds of thousands, and made for the banks which remained high and dry. The screeching and snarling of the rats as they fought for foothold

beggared description. Many were, doubtless, drowned by the inundation, but being, for the most part, expert swimmers, the impression made on the numbers of the great army was practically nil."

An armed expedition was equally ineffective, and, as usual, Nature's plague was only stayed by Nature's remedy.

DOUGLAS ENGLISH.

BRITISH FRESH-WATER FISH AND THEIR HAUNTS

By WALTER M. GALLICHAN

With Illustrations from Photographs by Mrs. C. G. GALLICHAN.

THE SALMON

THE mystery of the Salmon has not been solved, though year by year, through the patient observation of students of the natural history of fish and the testimony of anglers, a little more knowledge is added to our rather scanty Salmon lore. Townsfolk are well accustomed to the sight of glistening Salmon lying amid melting ice on the marble slabs of fishmongers' shops; but this spectacle of our noblest fresh-water fish gives no hint of its interesting and adventurous life to the passer-by. Nor is the romance of the Salmon suggested by the collops of pink flesh served as one of the courses of a dinner. To know the strange ways of this fascinating and bewildering fish, one must visit the spawning "redds" in winter, linger by the river pools at twilight, watch the waterfalls and Salmon passes during the season of migration from the sea, and go down in the fishing boats to the bay.

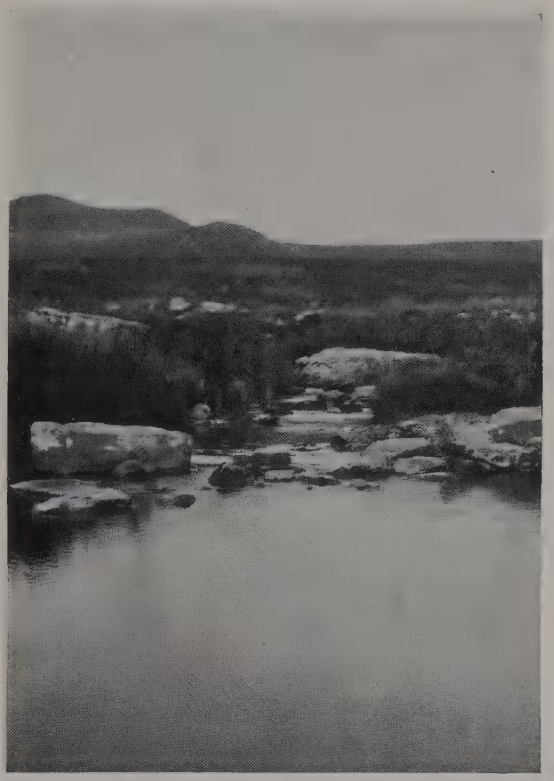
Even those who live by catching Salmon in nets, and the fishermen who angle for them with a rod and line, possess only an imperfect knowledge of the habits of *salmo salar*. I have known rustic anglers who, to the end of their days, have believed that the Salmon-trout is the young of the Salmon. And there are fishermen, not wanting in general intelligence, who are quite certain that the Salmon devours large numbers of other fish in fresh water. But the scientific investigator into the habits of the Salmon will rarely admit that he is positively assured concerning many important points connected with the diet, the customs, and the wariness of this remarkable fish; while the question of its extraordinary power of growth is one of the wonders of life.

One of the illustrations to this article (p. 425) shows the birthplace of Salmon in the upper reaches of a river in Wales. This spawning-ground is about fifty miles from the sea. It has a clean bed of gravel, where the female Salmon deposits her eggs, or spawn, and upon which the attendant male spreads the fertilising milt. Here several pairs of the fish congregate during November, and for many days their whole energy is concentrated upon the great undertaking of laying and protecting the ova. The mother fish is so intent upon the careful hatching of the spawn that one may approach quite near her, while the male hovers close by, to guard her and the potential offspring from enemies. At this pairing time the male fish are very pugnacious, and they develop a hooked "fighting jaw."

It is during the spawning process that the Salmon poacher takes his share of ill-conditioned fish, for the Salmon are listless and somewhat dazed, their abstrac-

tion resembling that of the sitting hen, which will not leave her eggs unless driven by force. At night, guided by the flare of a torch, or a lantern light, the fish-stealer wades into the water, armed with a spear or a "gaff,"—a sharp hook on a pole, or attached to a cord—and stabs and snatches the torpid Salmon. Although spawning Salmon are unfit for human food, there are parts of the country where unseasonable fish are captured, smoked, and sold privately.

Upon this destruction of spawning Salmon no owner of fisheries, or fair fisherman, cares to reflect. It means the loss of both the parents and the eggs, and affords an example of the truth that man is one of the supreme agents of destruction to the lower animals.



SPAWNING-GROUND OF SALMON ON A WELSH RIVER.

On well-guarded rivers, and in favourable seasons, the operation of spawning proceeds unhindered, and in due time the reach of the river is populated by thousands of diminutive fry. These grow to about three or four inches in length within a few months of their birth, and are then plainly recognisable as the young of the Salmon. In some rivers they are called "Samlets"; in other streams they are described as "Salmon-parr," or "last-springs." To me the most appropriate name seems to be "Samlet," *i.e.* a little Salmon—used in the same sense as Troutlet or young Trout.

The illustration "A Haunt of Samlets," on p. 426, shows a shallow, rippling stretch of a river, such as these little fish love. Here, on a bright day, when the sun reveals every stone on the bottom, may be seen the Samlets darting about, and occasionally rising to the surface, to catch a floating insect. The infant Salmon is very voracious. It rises recklessly to the angler's artificial flies, and seizes a baited hook with avidity. Fortunately, the penalty of a fine of five pounds deters a large number of village lads and unscrupulous fishermen from retaining Samlets taken on the hook when fishing for Trout. In appearance, the Samlet is so like a small Trout that many beginners in angling are unable to distinguish one from the other. But the points of dissimilarity are soon learned. The scales of a Samlet are smaller and more silvery than those of a Trout, and they are easily removed with the finger. In a Samlet, the fleshy or adipose fin, near the tail, is of a slaty grey colour, but in the Trout it is more or less tinged with bright red. A Samlet has also well-defined black markings along the back, resembling the print of finger-tips.

After a sojourn of some months in the rivers, the Samlets begin to experience a sense of restlessness and an impulse to travel down the stream until they reach salt water. It is during this first visit to the sea that they incur many perils.

A HAUNT OF SAMLETS.

On their journey they are often assailed by predatory fish, such as the pike; and upon entering the tidal waters they are exposed to the depredations of many hungry fish, and flocks of gulls, besides diving birds, like the swift-swimming cormorant. Probably not ten per cent. of these little rovers will ever return to the river of their birth. They perish by the thousand in the foe-haunted sea.

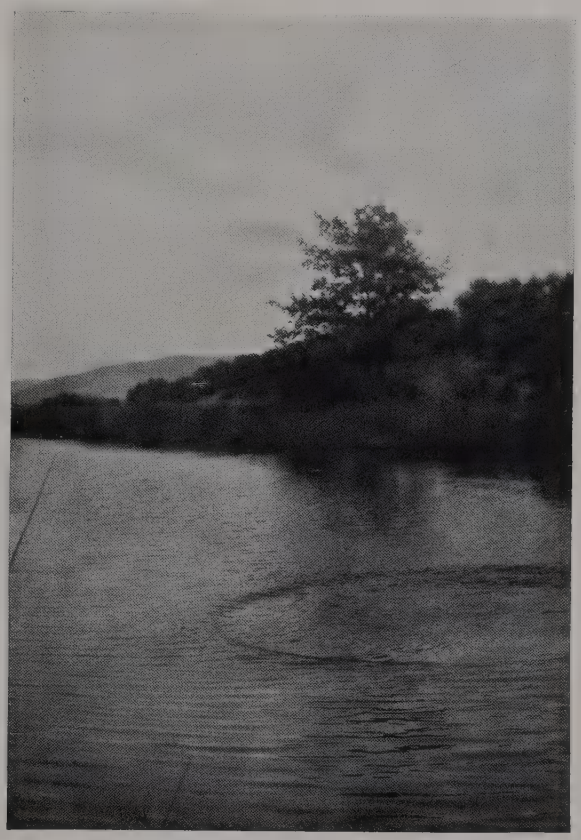
A WEIR IN LOW WATER—WHICH IS NO OBSTACLE TO A BOLD SALMON

The surviving Samlets grow apace in the bay. In a few short months they are eager to ascend to fresh water; and by this time—marvellous to relate—they have attained the weight of from four to six pounds! Such is the result of a sea-water diet. Perhaps even stranger is the mysterious faculty which enables the grilse, or Salmon, in its first river journey to find its way to the water in which it was bred. What guides it from the sea, up the estuary, past the outlets of numerous minor streams, to the river in which its Samlet days were spent? This is a riddle that naturalists have tried to answer.

One of our painstaking investigators, Frank Buckland, tells of a Salmon ascending the Bristol Channel. It is urged on by the migratory impulse, and it comes to the mouth of a river, down which a turbid flood is hastening. From the appearance of the stream all the conditions for the expedition are favourable, for the water will be almost level with the weirs, the shallows well covered, and the upper reaches swollen. Why does the Salmon pause before entering this river? Because it is a Salmon born in the Severn, and to that river, and to no other, will it return. This river may be the Usk, or the Wye, or a lesser stream flowing into the Severn Sea, and there is apparently nothing to indicate to the Salmon that this is not the Severn fresh water pouring into the estuary. Nevertheless, the fish knows the savour of its own river, and, without turning aside, it swims on to the Severn. Is the guiding instinct a power of scent? Who can determine this problem?

Having reached the sweet, fresh water of its native river, the Salmon frolics in very joy, and travels on till it finds a pool that affords deep water and hiding-places. So long as the stream is in flood, the Salmon will frequent the streams as well as the pools; but as soon as the water sinks, and the shallows begin to suggest danger, the wary fish will take up quarters in a quiet, deep eddy, or in a big, shadowy pool.

But I am forgetting the risks that the travelling Salmon runs in its journey up from the sea. Its first peril are the nets in the tidal water during the net-fishing season, and in some rivers there are spread so many of these that it is almost a miracle that any Salmon escape them. Then there are the difficult falls, ill-provided with passes or ladders for the fish to ascend, and these must be surmounted with a leap. This is often a desperate business. When the flood subsides, some of the weirs stand high above the stream below, and the Salmon has to fight his way up them, among a mighty



A SALMON POOL AT EVENING.
The rings on the water show where a Salmon has risen.

FALL ASCENDED BY SALMON IN FLOOD TIME.

" push " of foaming water, or to clear the fall with a tremendous bound. One of our pictures shows a weir, in a low state of the water, which is, however, no obstacle to a bold Salmon; while in the illustration on this page is shown a waterfall in the higher waters of a stream in the uplands, which roving Salmon ascend in time of flood.

I shall not express any positive opinion upon the diet of Salmon in fresh water. An examination of the stomachs of hundreds of Salmon taken from rivers has not afforded an explanation of the mystery. In by far the larger number of instances, the digestive organs have shown no trace whatever of food. Lately, however, anglers have stated that, very rarely, half-digested fish have been found inside Salmon caught in fresh water.

" If the Salmon does not eat fish in the rivers, why does he seize a small fish when used as a spinning bait by a fisherman?" is a question often put to those who deny that Salmon feed in fresh water. My own answer must be: " I cannot say." I know that there are two or three views upon this curious fact, and I am disposed to believe that the opinion that a Salmon takes a fly or a bait out of an excited curiosity alone is not altogether without a basis.

It has been stated that Salmon *do* feed in fresh water, and that their food consists of those very minute jelly-like creatures that are to be found in all river water. There may be truth in this, for fish certainly live for a long time in captivity in water into which no food is introduced.

The so-called " flies " used by Salmon fishers certainly bear very little resemblance to any natural insect seen upon the rivers; and, moreover, it has not been finally proved that Salmon seize natural floating insects. Yet they will take a bunch of gaudy feathers, tied on to a hook, a dead prawn, a spoonbait, or a spinning gudgeon. If hunger is not the prompting impulse to seize a bait, what can be the explanation? This question constantly recurs whenever Salmon anglers gather together. I can only reply in the words of an old fisherman on the Dee, " You see, a Salmon is a very irritable, bad-tempered fish, and when he sees anything that he does not like the look of, he says, ' If you come near me again I'll snap at you.' And that's why, after the twentieth or the fiftieth cast, he takes your fly. He gets so irritated, he cannot stand it any longer."

A good Salmon season depends upon the state of the weather and the rivers. Salmon will not ascend very cold streams or waters containing melting snow; and they are easily deterred from travelling

in fresh water when the streams are low through drought. Generally speaking, Salmon are plentiful in the rivers in a wet season. In times of heavy rainfall, they enter small tributaries and rivulets, and remain in them until the water subsides. The brook that a man can bound across will often hold Salmon during a rainy winter, and even during an August flood a few fish will venture into it. Some seasons are notable for the number of big Salmon captured in the nets at the mouths of rivers, and by anglers in the streams, while others are remarkable for the scarcity of the heavier fish.

A twenty-pound Salmon is a fine fish, but there are much weightier Salmon in our waters. Fishermen regard a "fifty-pounder" as a splendid prize indeed, and yet this is by no means the "record weight" for Salmon. Seventy and eighty pounds are not common weights for Salmon, though fish of this great growth have been caught. The enormous weight of 103 lb. has been recently recorded by Mr. W. L. Calderwood, the Inspector of Fisheries for Scotland, who states that this biggest of all British Salmon was caught in the Forth, a few miles below Stirling. It was a dark-coloured, male fish. The Tay, in 1869, yielded a Salmon of 84 lb., which was, up to that date, the heaviest fish of its species taken in our British waters.

There are several causes that tend to the decrease in the number of Salmon in the rivers of the United Kingdom. The most important of these is pollution of the waters, through washings from lead and other mines, or the presence of sewage matter in the rivers. Although stringent measures have been taken to inhibit the contamination of some of our best Salmon streams, there are rivers, such as the Ystwyth in Wales, which are now quite fishless through pollution from mines. At one time Salmon ascended the Thames, and efforts are now being made to restock the river with these fish. But while the tidal waters contain impurities deterrent to travelling Salmon, the experiment is doomed to failure. There is, however, hope that the Thames is becoming a purer stream below London Bridge. Perhaps within the next twenty years we may see fresh-run Salmon leaping in Teddington Weirpool.

WALTER M. GALLICHAN.

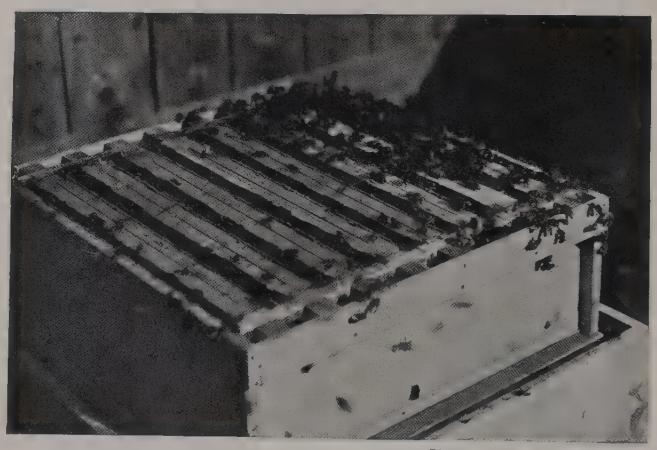
A SHALLOW THAT SALMON WILL NOT CROSS.

BEES AND THEIR WAYS

By T. H. YELDHAM

THE life of the Bee and its method of work in a wild state are practically unaltered when the insect is tended and kept for profit; the only difference is that under the latter conditions its ways are controlled and its work regulated.

In a wild state, Bees will form a colony in almost any weather-proof recess, such as a hollow tree-trunk, a house roof or church tower.



Photograph by Pictorial Agency.

BEE-HIVE WITH TOP REMOVED.

The old-fashioned skep, though by no means so useful or profitable for bee-keeping as the modern wooden hive, affords very good means for the study of Bees as they live in their wild state. If a swarm be placed in a skep, or allowed to seek out for themselves a hollow tree-trunk, they will, after deciding that it is suitable for their new home, start work at once. Some of the Bees will go up to the highest point in the dome and there set to work. Taking small pieces of wax from the plates on the under sides of their bodies where it is produced, they work it with their strong jaws or mandibles, till it is soft and pliable, then they build from the roof a small piece of comb. Using their bodies as plumb-lines, they hang down in rows and festoons, building downwards. As this comb increases in size other Bees commence to build a similar comb on each side parallel to the first, and as these combs become larger others are again built on each side. So the process goes on, the combs all hanging downwards, parallel to each other, and about an inch and a half from midrib to midrib, until at last the whole skep or hollow is filled with combs, with the exception of a small space at the bottom just large enough to allow the passage of a Bee's body.

While this work is going on some of the Bees guard the entrance, and a Bee from any other colony which attempted to enter would be repulsed or killed, though sometimes if the intruder be heavily laden with honey it is allowed to enter, deposit its honey and depart. But under no other circumstances would a stranger be allowed to enter, or, having entered, to escape alive. Other members of the colony are out gathering honey, and returning at intervals to deposit their harvest in the cells, and the queen Bee is busy laying eggs at the rate of perhaps two thousand a day. She lays these eggs, passing from cell to cell, and comb to comb, in such a way that the brood nest is in the form of a sphere, the outer cells not so utilised being used for storing food.

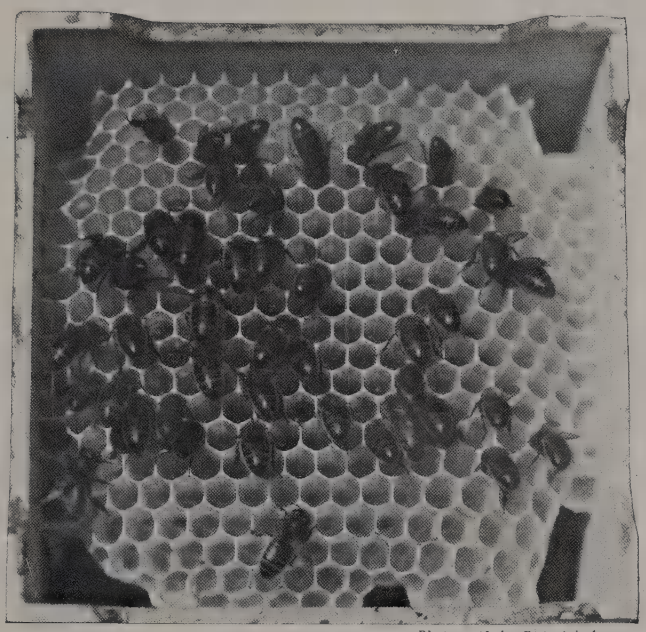
The queen is followed always by several Bees, whose duty it is to feed and groom her when necessary, and to see that the eggs are properly looked after. It was this retinue of attendants which gave rise to the old idea that the egg-producing Bee is queen, and the others her courtiers. In reality she is no queen and never issues orders, as the Bees live an ideal socialistic life. She is, indeed, the mother Bee, but is more slave than queen. She is fed and groomed by attendants so as to enable her to give her whole life and energy to the task of laying eggs.

While all this work of comb-building, egg-laying and honey-gathering is going on, other Bees are busy feeding the hatched grubs, which are curled up like crescents in the bottoms of the cells. These grubs grow till they are so big that they have to lie lengthwise in the cell. When this stage is reached the attendant Bees place a supply of honey and pollen in the mouth of the cell and seal it over with a porous covering. So the grub remains while it passes from grub to chrysalis, from chrysalis to nymph, and from nymph to perfect Bee. It casts its skin at each change.

After about three weeks from the time the egg was laid, a little black shiny point pierces the capping, and with a sawing motion cuts round it—as a tin-opener cuts a tin—till the circle is nearly complete. Then the Bee—economic of labour from its birth—pushes its way out, leaving the unsevered portion of the cell covering to form a hinge on which it swings back.

The first twelve hours of a Bee's existence are spent in idle luxury. With wonderful instinct it then sets to work to attend to the unhatched Bees. It follows this work for about a fortnight, when its place is taken by younger Bees, and it is free to start on its glorious outdoor life, gathering honey and pollen for immediate use, and helping to swell the stores that will keep its yet unborn sisters through the impending famine of winter when she herself is dead, worn out by unselfish work.

In its work of honey-gathering, a Bee will never enter a bell-shaped flower where there is another Bee, though on flat-shaped flowers, such as gaillardias, more than one is often seen. Once visiting a flower a Bee will go to no other variety until it has returned to the hive to deposit its honey and remove the pollen that has adhered to it. This instinct is one of Nature's provisions for the prevention of pollen from one variety of flower being carried to another, and of ensuring the fertilisation of the flowers. For all Bee-visited flowers are so wonderfully designed in shape and size that while it gathers the nectar, the Bee collects pollen upon its body in such a manner that the fertilisation of the next flower is unfailingly ensured. The many ways in which this accurate placing of pollen is secured are far too numerous to mention here, but one interesting instance is that connected with the sweet pea. A Bee



Photograph by Pictorial Agency.

BEES AT WORK ON A SECTION OF THE COMB.

when visiting this flower hovers near it and then alights upon the upward curving lower petals. Immediately it settles its weight presses these petals down and partially opens them; the stigma and pollen-laden anthers, which are at first

Photograph by Pictorial Agency.
BEE ON A GAILLARDIA.

pressed down, now become suddenly released, spring upwards, and strike the Bee on the under side of the body. By this action pollen for the fertilisation of other flowers is sprinkled on the Bee, while the stigma gathers pollen brought by the Bee from flowers it has previously visited. The Bee for this service receives the nectar from the flower and the pollen left over after fertilisation, which pollen it rolls into little balls and carries in the concave part of one of its pairs of legs to its storehouse. Some flowers deposit the pollen on the upper side of the Bee's body just behind the head, and on the return of the insect to the hive it will be removed by other Bees, while the carrier Bee is storing its honey in the cell.

When the honey cell is full it remains open until its contents have evaporated to the requisite consistency, and the Bees then "sting" the honey (which accounts for its pungent taste) to prevent fermentation, and seal it over with a capping of wax.

In addition to the pollen and honey Bees also gather a dark greenish-black wax called propolis, from resinous trees and shrubs, which is used to stop up holes in the hive, or to seal over objectionable matter which is too large or heavy for them to remove. Beeswax itself is a product of their own bodies, and when new is almost, or quite, white.

Sometimes instead of gathering honey a Bee will act as sentry, or serve amongst the number which stand outside on the alighting board with heads toward the entrance, and work their wings as fans to draw out the air and ventilate the hive.

The worker Bees described above are all imperfect females; the queen is the only perfect female, and hence is the mother Bee of the hive. The drones, or males, of a community number about four or five hundred, and the workers twenty to sixty thousand.

The drone's life is a short and a merry one, but with a tragic ending. They appear first in the spring, or early summer, and live a life of selfish idleness, enjoying the glorious sunshine, doing no work, feeding when they wish on the stores gathered by the workers, and being treated with respect and consideration

Photograph by Pictorial Agency.
BEE ENTERING A CANTERBURY BELL BLOSSOM.

by their industrious sisters. But what a fate is in store for them when summer wanes and the honey supply fails! A signal passes through the hive and the workers turn upon them simultaneously,

and, as if to revenge themselves upon them, drive them from the hive to perish miserably of cold and hunger. Many fall to the ground with wings and legs torn off, and bodies battered and broken. Are the injuries caused in the struggle, or is it intentional cruelty ? Who can say ?

As winter approaches the Bees rarely go out, but cluster closely for warmth, and as the outer Bees get chilled they come into the centre of the living ball to regain warmth, while others take their places on the outside.

During the winter, when there is little work to be done, the workers live on until the new brood hatches in the spring, but in the summer they work night and day, and wear themselves to death in the brief space of about six weeks. The drones, as already stated, live but one season, and the queen (in her prime for three years) will sometimes live for four or five years, but frequently, as her egg-laying powers decrease, she is put to death by the workers, and a new queen raised from one of her own eggs. In May, June or July—it sometimes happens, though rarely, in April—if the honey-flow is good and the hive crowded, the Bees will "swarm"—an event which forms one of the most interesting in their life's history.

To realise exactly what this means we must trace the development of a queen Bee. The workers build a special cell which is shaped like an inverted acorn, and in which the queen lays an egg; or sometimes the Bees may take a newly laid egg from a worker cell and place it there, or even build a queen cell round it where it lies. There the queen is reared. It often happens that several queen cells are found in a hive at the same time. The first hatched queen tears open the other queen-cells and kills their occupants, or if not allowed to do so, sometimes leaves the hive with a small number of Bees—which is called an "after swarm" or "cast"; or, again, she may remain, and when the next queen is hatched, fight to the death for the motherhood of the hive. Here again is seen a wonderful provision of Nature, for in the fight for supremacy the two queens hover round each other, watching, and trying for an opening, but never striking till the blow is certain death, for the victor must be uninjured, as on the perfection of her body depends the future welfare of her colony.

When the new queen has rid herself of her rivals she must turn her attention to matrimony, and that within a fortnight of her birth, or she will be unable to fulfil her duties. Even now she is capable of laying fertile eggs, but these invariably produce drones and never worker Bees.

Choosing a bright sunny day, the young queen starts upon her marriage flight, and though she may have previously taken short excursions, the drones are at once aware of the import of this occasion. As she flies swiftly upwards they follow hard upon her, but she outstrips them all, and one by one the weaker fail until at length, far up out of sight, she is left alone with the last and strongest drone, who, in catching her, reaches not only the end of his race but the end of his life, for he falls back dead. The queen Bee returns to the hive to take up her duties of motherhood, and never again meets a drone, or leaves the hive, except to "swarm." Yet her marvellous power enables her to lay two to three thousand eggs a day in the height of summer, and so to continue for three, four, or even five years, laying either male or female eggs at will.

Shortly before the new queen is due to be hatched the old queen leaves the hive with a swarm of Bees numbering some thousands. The joyous sound of the Bees when swarming can be heard some distance off, and as the black cloud issues from the hive it seems incredible that so many could be contained therein; but there are still as many, or more, left. If not taken and placed in a hive the swarm will send out sentinels to find a hollow suitable for a new home, and usually depart for it at sundown, though sometimes they stay clustered where they have swarmed (usually a bush or branch of a tree) for two days or more.

So the Bee colonies are increased. Swarming is, indeed, Nature's method of saving from annihilation and increasing the number of the Bees, whose work is so necessary in the fertilisation of much of the vegetation that supports life, and makes the world beautiful.

T. H. YELDHAM.

HONEYSUCKLE HEDGE.

HOW TO KNOW THE WILD FLOWERS

By the REV. H. PUREFOY FITZGERALD, F.L.S.
With Photographs by HENRY IRVING

THE FLOWERS OF THE HEDGE-CLIMBERS—I

HONEYSUCKLE

THE Honeysuckle (*Lonicera Periclymenum*) needs but very slight introduction, for its beauty and fragrance must be well known to everyone. The Woodbine, as it is frequently called, possesses a very tough stem, and, like the Convolvulus or Bindweed, always twines from left to right; it very often grows as much as twenty feet in length. The leaves, which are egg-shaped and generally slightly hairy underneath, grow in pairs, of which the lower ones only have stalks. The flowers grow in terminal bunches, and all spring from one point at the extremities of the branches; they vary in colour, being white, pink and yellow. The blossom consists of an elongated tube, which is deeply cleft, so that it appears to be composed of

four or five petals; the five stamens protrude from the mouth, and are generally curled and twisted, the long style of the pistil being in the centre. Each blossom secretes a large quantity of honey which is inaccessible to small insects, and the flowers are fertilised chiefly by the bigger moths. For this reason the Honeysuckle is most fragrant in the evening, when the other insects have retired to rest. The fruit assumes various tints before it is ripe—green, yellow and orange. In the autumn it is to be seen in the form of red, transparent berries.

Another species of Honeysuckle, which has been introduced into this country and, consequently, is somewhat local, is the Perfoliate Honeysuckle (*Lonicera caprifolium*). The leaves of this plant are joined together at the base, so that the stem appears to be coming through the centre of one leaf. The flowers are much longer than those of the common kind, and appear during the late spring and early summer, being succeeded by bright orange berries.

WILD ROSE

The species and varieties of the Wild Rose are very numerous, and botanists find it very difficult to distinguish between them all; but with these subtle differences we need have nothing to do. The commonest hedge rose is the Dog Rose (*Rosa canina*). The flowers are large, pink or white, and only faintly scented; the flowering stems are weak and straggling, and bear curved, very pointed prickles. The green sepals are usually turned back towards the stem when the blossom is open, and this fact will help us to distinguish this species from the Field Rose (*Rosa arvensis*), for in this plant the sepals drop off when the flowers open. The Field Rose has more of a trailing

DOG ROSE HEDGE.

FIELD ROSE.

habit, and bears its flowers more in clusters than does the Dog Rose, and the whole plant is more slender and the hooked prickles on the stem are smaller, though none the less sharp; the blooms, also, are always white, and the flowering season lasts much longer.

In both species the fruit is more or less globular; the scarlet "hips" are well-known adornments of the hedges in the autumn. The differences in general growth will be well seen in the photographs. The Sweet Briar, or Eglantine, (*Rosa rubiginosa*) is found principally in chalky districts, and is easily recognised by the odour of its foliage. The scent is produced in small glands spread about on the leaves, which gives the plant a somewhat rusty appearance. The flowers are solitary, pink, and rather smaller than those of the Dog Rose, whilst the fruit is egg-shaped, the broader portion being farthest away from the stalk. The Burnet Rose (*Rosa spinosissima*) — from which has been developed the cultivated Scotch Roses—is found chiefly near the sea, growing on dry, waste land; it is very different from the hedge roses, as it is an erect little shrub, seldom more than two feet high. It bears small, white, solitary flowers, with very prickly, straight thorns, while the fruit is dark purple in colour.

H. Purefoy FitzGerald.

BIRCHES AT FAIRCROP.

From the Water-Colour Drawing by Mrs. Rawnsley.

LULWORTH COVE.
Showing the contortions of the strata in the face of the cliff.

THE CLIFFS AND THEIR STORY—II

By F. MARTIN DUNCAN, F.R.P.S.

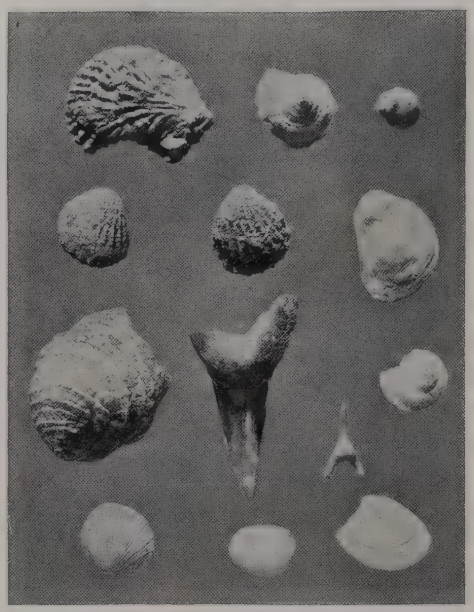
With Photographs by the Author

ONE of the most remarkable stretches of coast, at once for its picturesqueness and varied character, is to be found between Barton Cliff in Hampshire and Lulworth Cove in Dorset. If we ramble over this area of coast, we shall find the cliffs varying to a wonderful degree, in height and shape, while the fossil remains stored within them will yield most eloquent illustration to the story of their formation.

Wind, rain, and tide are for ever busy upon the Barton Cliffs, undermining, wearing away, so that fresh surfaces are constantly being exposed, in which the fossil remains of the creatures which existed during that period of the earth's history when the Barton clay was forming are clearly visible, and may, with the exercise of a little care and patience, be extracted from the clay in which they are embedded. Indeed, the Barton Cliffs are quite a happy hunting-ground for the collector of fossils, and they are of particular interest, because the Barton clay is quite a local deposit, which on stratigraphical and palæontological grounds is considered to be the equivalent

of the clays that lie between the Upper and Lower Bagshot Sands.

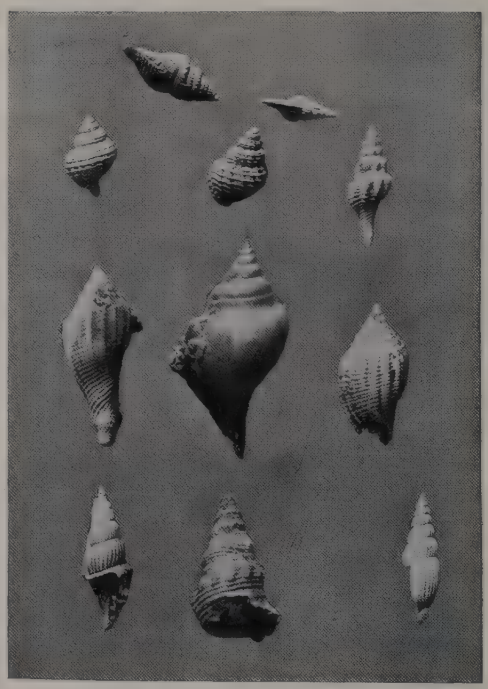
A careful examination of the fossils



FOSSIL SHELLS AND SHARKS' TEETH FROM BARTON CLIFFS.

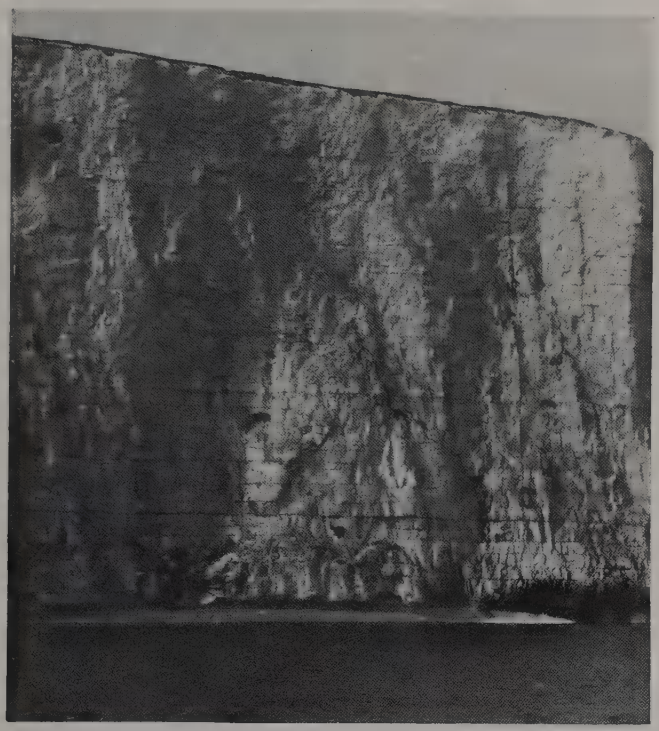
that we may collect—and they are likely to be fairly numerous—will enable us to piece together the story of the Barton Cliffs. Amongst the fossils that have been found here are to be numbered more than two hundred species of marine shells, the remains of a few species of fish, sharks, and a crocodile (*C. Hastingsiæ*), together with the fossil remains of extinct species of Sennas, Figs, Dryandra, Laurels, Cypress, Spindle-trees, Yews, and Limes. The most abundant genera of the fossil shells are Chama, Fusus, Voluta, and Crassatella, and a peculiar genera of Univalve shells with tubular spines called Typhis. Although no such fauna is to be met with anywhere at the present day, it nevertheless is something like a mixture of the existing forms of marine life peculiar to Malay and New Zealand. For instance, the fossil Crassatella, Chama, and Typhis are very similar to species now living in the New Zealand seas, and in fact there is a general and unmistakable tropical character about these fossil remains.

From this characteristic appearance of the fossil shells, we learn that when the Barton Cliffs were forming beneath the surface of the sea, the climatic conditions which existed must have been similar to those met with to-day in Malay. The numerous fossil plants give ample evidence of the vicinity of land, and the fossil crocodiles of the existence of an ancient river—for there is no reason to suppose that crocodiles have altered very much in their habits; the modern crocodile is to be met with at the mouths of tropical rivers, in the comparatively shallow salt water, but does not pursue its prey into the open sea. So the chain of evidence is linked up by the aid of these fossil remains compared with the somewhat similar forms of life to be found on the land and in the seas of to-day. They enable us to read the story of these cliffs; how in a long past geological age they were deposited within the ocean mouth, or mouths, of some great tropical river similar to the Ganges or the Amazon.



A GROUP OF SHELLS FROM BARTON CLIFFS.

Westward along the coast from Barton and Bournemouth the land gently slopes down to the wonderful and beautiful



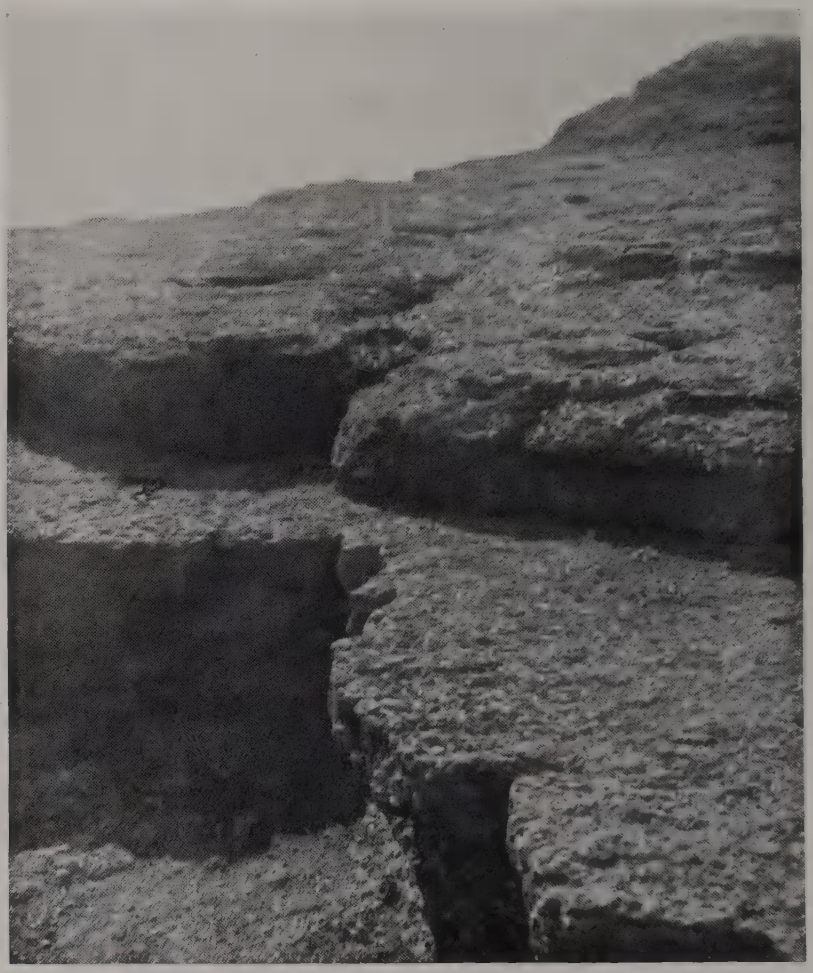
NEAR THE BALLARD FAULT, SWANAGE.
The cliffs show how they were first formed in horizontal layers.

basin of Poole Harbour, where fresh, brackish, and marine deposits are forming to-day, which in some future geological age will form dry land, and will hold the fossil remains of the flora and fauna of our day. A steamer trip from Bournemouth to Swanage affords a good view of the chalk cliffs that abruptly rise west of the entrance to Poole Harbour. We steam past the "Old Harry" and Pinnacles, two magnificent towers of detached chalk, and directly we have passed the latter we see the face of the cliff marked by horizontal layers of flints. Further on is the towering height of Ballard Point, and just before we come abreast of it we shall see the famous Fault in the face of the cliff, where the layers of flint are no longer horizontal, but have been distorted and crushed into vertical and curved layers. We vaguely realise the stupendous force that was required to produce this Fault in the strata, when we see that the flints have been crushed and broken into fragments.

At Swanage Bay we come upon the wonderful Wealden formation the thickness of which series

THE BALLARD FAULT, SWANAGE.
Showing how the horizontal layers have been forced upwards to the vertical.

as seen at Swanage is computed at not less than 2,000 feet. This Wealden formation is of extraordinary interest, because its fossil remains give us some insight into the story of the nature of the terrestrial fauna of that epoch in the history of the earth known to geologists as the Lower Cretaceous, and also because it underlies a deep-sea deposit. No one with the least spark of imagination or intelligence can look upon those wonderful cliffs between Swanage and Lulworth Cove without being deeply impressed. What an eloquent story they have to tell of the almost infinite age of the earth, and the immense powers of Nature! Standing at the foot of those cliffs, surrounded by the gigantic ruins of Nature's masonry, with the air full of the majestic music of the sea and wind, how insignificant the work of man becomes; how poor and paltry the strife, cheating, petty meanness and utter selfishness of his vaunted twentieth-century civilisation!



"FAR ABOVE THE REACH OF THE WAVES TO-DAY THESE WONDERFUL ROCKS, COMPOSED OF FOSSIL OYSTER SHELLS, TELL HOW THE CLIFFS WERE FORMED AT THE BOTTOM OF AN ANCIENT SEA."

No figures can convey to the human mind the period of time required for the formation of these Wealden and Purbeck

strata, but from their fossil remains we can picture their story. Imagine a great delta covering an area of some 30,000 square miles, through which a broad and noble river slowly flows down to an ancient sea. On the flats by the river there are growing Equisetums of gigantic

PART OF THE FOSSIL FOREST AT LULWORTH CLIFFS.
Note the great cast of an ancient tree trunk in the foreground.

size in the marshes, and ferns, coniferous trees, Zamias, and Cycads on the dryer grounds. Crocodiles, turtles, fish and shell-dwellers (*mollusca*) swarmed in the waters of this ancient river, while small marsupial mammals lived upon its banks, along with those gigantic reptiles, the Iguanodon and Megalosaurus, and the strange, winged, bird-reptile, Pterodactyle, preyed upon the insects that flitted through the warm tropical air of a climate similar to that of the India of to-day.

Very gradually this ancient delta sank down and was submerged, with its forests, beneath a body of fresh water, from which sediment was thrown down. The sea slowly but surely encroached, and left its record in the great and conspicuous stratum, some twelve feet thick, formed of a vast accumulation of fossil oyster shells (*Ostrea distorta*), locally called the "Cinder-bed." In turn this shallow sea deepened, and the chalk of which the downs surrounding Lulworth Cove are formed was deposited. Then the land began to rise again, until the chalk, the "Cinder-bed," and ancient delta have assumed their present position above the level of the sea. It is truly as wonderful a chapter from the history of the earth as we are likely to meet with, and one that it is impossible to do full justice to within the limits of this article.

All round the coasts of Great Britain and Ireland the cliffs have eloquent and wonderful stories to tell us, if we will

but take a little trouble to examine their exposed surfaces, and to seek the many interesting fossil treasures which they contain. Journeying on, for instance, from Lulworth to Lyme Regis, we should come to the wonderful Lias formation, and from the fossil remains reconstruct the story of those blue-black clay cliffs, and of the strange marine and terrestrial saurians which lived during the period of their formation. And so the longest holiday or sojourn by the sea need never have a dull or uninteresting hour, for when we cannot hunt for the countless treasures of Neptune's Kingdom we may wander along the cliffs and glean the many marvels of their story.

F. MARTIN DUNCAN.

HOW TO KNOW THE BIRDS

By the REV. MAURICE C. H. BIRD, M.A., M.B.O.U.

With Photographs by
RICHARD AND CHERRY KEARTON

THE WADERS—II

EVEN more watchful and wary than the amber-eyed Heron is the weird-voiced and crafty Curlew. Indeed, to be able to stalk successfully a lone Curlew is to have arrived at the acme of perfection in the exciting sport of shore shooting. Generally these dark and pale brown and white birds—about the size of a Wood Pigeon, though differing much in size according to sex and age—standing high on the leg, and with elongated sickle-shaped beak, are to be met with on the sea-shore or mudflats in flocks. Sometimes several hundred herd together. In changing their feeding grounds, or when flying inland to await the turn of the tide, they frequently arrange themselves, after the manner of wild-fowl and the larger Gulls, in wedge-shaped formation. When their ample wings are extended, on rising from the ground, the clear white rump patch is effectively displayed. "Whaup" is another phonetic name given to the onomatopoetic Curlew, but the latter designation is a better aid to identification—the sad, wailing tone, in which the more familiar word is uttered by the loudest voiced of British shore-birds, being unmistakable. The frequency of its nightly complainings amidst dark and lonely surroundings gave rise to much ancient folk lore. In May the Curlews that remain here retire for the purpose of nesting to the moorland, and scatter themselves over the wildest and most unfrequented districts.

During the months of August and September is the best time for observing all shore-birds, as they are then intent on migration, and have many young and inexperienced individuals amongst them. They are then not only more numerous on our coast-line than at any other season of the year, and more easy of approach, but there is then the best chance for the ornithologist to meet with a rare accidental visitor amongst their ranks.

Very similar in shape, plumage and habits, though smaller in size than a Curlew, is the Whimbrel. It is to be distinguished at close quarters by the darker plumage and much darker head; the two dark marks on the crown are divided by a very pale centre stripe, much after the similarly situated plumage of the Snipe. The call-note of the Whimbrel, "tetty-tetty-tet," quiveringly uttered, and repeated several times, has given it the local nickname of "Titterel." A remembrance of this fact will assist in the

identification of the bird when it passes over one's head at such a height that no other means of recognition are possible. It is never so numerous here as the Curlew, nor does it stay to breed with us.

Two other birds very similar to one another, but slightly smaller than the foregoing, are the Black-tailed and Bar-tailed Godwits, which are sixteen and fifteen inches in length, respectively. The rarer Black-tailed bird is much longer on the leg than the Bar-tail, whose beak is slightly curved upwards, whilst in the other species it is nearly straight. The rump of the Black-tail, too, is white, whereas the smaller bird has the whole back uniformly coloured with light and dark brown markings, and might, were it not for the very distinct difference of the beak, be easily mistaken for a small-sized Whimbrel. Neither species now breeds here, and only occurs regularly at spring and autumn migration.

Greenshank and Redshank may be taken together, although the former is a rare bird compared with the latter, which may be met with at any season of the year — singly or in flocks on the sea coast in autumn and winter, or breeding on our coast-line and inland marshes, where many pairs still build their well-concealed nests amidst the grass and rushes, during the spring and summer months. The incessantly uttered breeding cry — "tew-tew-tewy" — of this bird in flight, when alarmed, is as unmistakable as its white rump and secondary wing feathers are noticeable. As its name implies, its legs, as well as its beak, are reddish orange in colour. During the breeding season I have often observed both it and the Common Snipe perching on marsh rails or on the dead bough of a tree; and the Green Sandpiper sometimes also indulges in the same somewhat unexpected proceeding. When on the sea-beach or saltings, Redshanks flock together or consort with other waders; but the larger Greenshank is a much more solitary bird, being generally met with singly. It is much wilder, too, and longer on the leg than the Redshank, and, in flight, looks very white, especially if the sun be

THE CURLEW.

YOUNG CURLEW.

shining brightly, although its upper plumage is grey and black; the explanation of this is that in its rapid aerial twistings the white underparts are frequently displayed.

The Green and Common Sandpipers are both of a bronzy green shade as to their upper plumage, which in the former is minutely dotted with white spots. It is, by a couple of inches, the larger bird of the two; its total length is about $2\frac{1}{2}$ inches short of a foot, and it stands comparatively higher on the leg than the Common Sandpiper. Both species haunt inland waters, never flock or keep company with other waders, and solitary individuals are most frequently met with. The Common Sandpiper is perhaps the most confiding wader we have, whilst the Green Sandpiper is one of the most shy, being off and away at the slightest alarm. Here, again, the white rump is a distinguishing feature between two very similar birds, for the common species is not thus conspicuously marked. Very rapid in flight is the peculiarly musky scented Green Sandpiper, which may be met with in almost any month of the year, especially when and where any cleaning out of marsh ditches has been recently effected on a large scale, for, to it, the resulting mud is very attractive. This bird has never been proved to breed in England, though from the peculiar habit of laying its eggs in the tree-built old nests of other species it may have escaped observation.

SANDPIPER ON NEST.

With this sole and remarkable exception, all Plovers and Sandpipers make a more or less cosy nest on the ground; and all lay four eggs to the clutch, which are protectively coloured as to their shells in various shades of buff, olive, and grey, blotched and streaked with black or rich brown. All are pyriform in shape—large compared with the size of the parent bird—and always placed in the nest with the smaller ends meeting together, so that the birds may more easily cover them. Photography has proved that, in several species at any rate, both sexes take turns in incubating. At the breeding season the Common Sandpiper resorts to the near neighbourhood of inland streams. It breeds in several counties of the United Kingdom, but chiefly in the north, and makes its nest at no great distance from the water. At such times it becomes especially tame, and the peculiar habit of head bobbing and tail jerking may then easily be watched, the hovering love-flight observed, and the plaintive tremulous "wheat-wheat" call heard.

WHIMBREL'S NEST AND EGGS.

Although the frequency with which the wily Woodcock appears in the game-dealers' shops greatly depends upon wind and weather, and the number of migrants from abroad, there is scarcely a county in England in which a pair or two of this much-sought-after bird do not remain to breed after the overlapping northern strangers have departed in early spring. As they are night feeders, however, Woodcock are seldom seen on the wing, except when flushed from their secluded resting-places by sportsmen, or when taking their evening love-flight during April. At this season they may, perchance, be met with chasing one another around the outskirts of wood or coppice, uttering meanwhile their peculiar toad-like croaking note. In October, when the chief of the migrants reach our eastern coast-line, Woodcocks may now and then be found in unexpected places—on the bare cliffs or sand-dunes, in open fields or by roadside fences—tired out by their sea passage. Under such circumstances they are often attracted by less powerful rays than those emanating from our lighthouses and lightships; the open door of a blacksmith's forge and the open window of a cottage have, to my knowledge, proved destructively alluring to more than one weary Woodcock. Besides the most beautifully harmonious blending of various shades of red and grey, black and brown of the bird's plumage—which so closely assimilates

to the decaying leaf-strewn ground upon which it rests by day, and from which it nightly extracts its diet of worms—the suppleness of the long and sensitive beak, nerved to the tip to assist in locating its squirming prey, should be noted. The size of the beady, brown-black eye—enlarged for the purpose of facilitating its nocturnal rambles—claims close attention, as does also the backward position of this highly developed organ. For if it were placed as near to the base of the bill as is the case with most birds, it would run the risk of becoming clogged with mud and dirt during the continuous process of probing for food. Another provision of Nature in connection with the Woodcock may be discovered by turning back the feathers below the eye and towards the gape, when the large ear-opening will be discovered. It is in a very unusually forward position, but is most advantageously situated for hearing the slightest movement in or on the soil surface whilst the bird is in quest of its lively victuals. Besides the conspicuous eye, by which sportsmen are poetically said to discern the whereabouts of a Woodcock, there is another striking item about this bird in the white tips to the under side of the tail feathers. These, however, are only visible when the bird flirts its tail upon alighting, and then, of course, one must be behind it to notice them at all. In the economy of Nature this small white patch may serve as an attraction in the courting display in which all birds indulge, however sombre their general plumage may be. It may also act as a sign-post or danger signal, after the manner of the more conspicuous white scut of a startled and departing rabbit. The weight of a Woodcock varies from 8 to 18 oz., according to the weather and food supply; and the length from 13½ to 14½ inches.

MALE AND FEMALE SNIPE COVERING CHICKS.

The chief distinguishing mark between the Jack and Common Snipe consists in their relative size; the latter larger and resident species measure from 9½ to 11 inches, according to age, and, I think, race. (The chief difference is in the beak.)

The lightest bird that I have ever weighed only scaled 3⅓ oz., and the heaviest 6½ oz., but 8 oz. has been recorded. Jacks are generally about 7½ in. long; and my lightest and heaviest recorded weights are 1⅓ oz. and 3¾ oz., respectively. The former weight is not infrequent in prolonged frost, with snow; but it is marvellous that a bird of this

size may lay an egg weighing more than an ounce!

With both Woodcock and Common Snipe flesh is rapidly lost during very severe weather, and as rapidly gained at its break up.

The Jack Snipe, besides its difference in size, and the comparative shortness of its beak, may be known from the full Snipe by its darker, more metallic blue-black back feathers, and the conspicuous dark cream-coloured stripe on either side when the wings are closed. The breast and belly of both Snipes are white, but in the Woodcock buff and black barred and vermiculated throughout, as is less definitely the case with the Great or Solitary Snipe, which, however, is only an irregular autumn visitor.

During the whole of its sojourn here, from the third week of September to the first week of April, the Jack Snipe is practically a silent and a solitary bird; it never collects in whisps, as the Common Snipe frequently does. Easily frightened as is the larger bird—one rising and "scaäping" frequently sends every other full Snipe into the air for yards around—the crouching Jacks will not take wing until almost trodden upon. However thickly they may lie, the disturbance of one will not result in the unsettling even of its nearest neighbour. If half a dozen of them are in the air together, each, on rising, will noiselessly depart quite independently of the direction taken by the others. Neither will any one fly far before it suddenly pitches down again.

Much correspondence has taken place anent the sounds made by the Common Snipe. Three of these are well known, two of which are vocal—the "scaäpe, scaäpe" note of alarm, regularly uttered when the bird is flushed, and the "chaächa, chaächa" breeding-call. The "baa-ing" noise made in flight (in summer flight I was going to say, but my note-books remind me that I have, at odd times, chronicled it in winter) is generally supposed to be made by the vibration of the tail feathers as the air rushes through them; though some people still contend that the quivering quill feathers of the wings aid in giving this wader the sobriquet of "summer lamb." Certain it is, however, that the deceptive and far-reaching "drumming" is made whilst the bird is descending through the air and facing the wind.

WOODCOCK'S NEST AND EGGS.

MAURICE C. H. BIRD.

GROUP OF MALES AND FEMALES OF THE SMOOTH NEWT.
The Female at the top of the picture is rising to the surface for air.

HOW TO KNOW THE AMPHIBIANS

By DOUGLAS ENGLISH, B.A., F.R.P.S.
Author of "Wee Tim'rous Beasties," "Beasties Courageous," etc.

THE NEWTS

THE GREAT WARTY NEWT. THE SMOOTH NEWT. THE PALMATED NEWT.

With Photographs by the Author

"AMPHIBIAN" is a term which strictly applies only to creatures which can respire either air or water; it is loosely applied, however, to air-breathing creatures of aquatic habit, such as seals or alligators, who spend as much of their lives in or under water as out of it; and it is also applied, in scientific terminology, to creatures who in the earliest stage of their free existence respire water, in a transition stage respire water or air, and in the final adult stage respire air. Two Orders of amphibians are represented in this country. The first, *Urodela* (= with obvious tails), embraces our three species of newts; the second, *Anura* (= tail-less), our two species of frogs and two species of toads. All seven of these species lay their eggs in water, and their tadpoles are, to commence with, purely aquatic, respiring water by means of gills, and remaining permanently below the surface. In the course of their development the gills atrophy, and eventually are replaced by air-breathing lungs. A transition stage occurs in which gills and lungs are simul-

taneously functional, and in rare instances British newts have been known to retain their gills in the adult state, and so remain amphibians in the strict sense of the word.

Whether they are capable of propagating in these circumstances has not yet been determined, but an analogous case is afforded by the North American Axolotl, whose ability to reproduce his kind led to his being at first regarded as a final product, though subsequent investigations proved him to be merely a tadpole whose development had been arrested, and who under favourable conditions would turn into an Amblystome. Nor need we go so far as America in search of an analogy, for it has been pointed out by Mr. Boulenger that Axolotl forms of the Alpine Newt, a *Urodele* closely allied to our own species, are comparatively abundant in some localities of the Italian Alps.

THE COURTSHIP ATTITUDE OF THE MALE AND FEMALE SMOOTH NEWT.

In some respects the amphibians supply material of unique value and interest to the biologist. This is due to the fact that their development can be studied literally *ab ovo*, and that such study is assisted by the relatively large size of the eggs, the transparency of their covering, and the transparency (in the early stages) of the tadpoles which hatch from them. The biologist thus sees before him the embryonic development of a vertebrate, and, from the evolution of the individual, is enabled to gain some insight into the evolution of vertebrates in general.

Our three British species of newts all breed in similar fashion. In late spring the adults take to the water, the Palmated Newt being somewhat in advance of the other two species. Where they all hide themselves during the cold months it is difficult to say. I have found them in the most unexpected situations: more than once I have dug them up a spade-depth below the surface, where no doubt they had reached a hibernaculum communicating with the outer air; more than once I have found them in cellars, and in the bricked recesses under gratings which give a glimmer of light to the basements of some old-fashioned houses; more than once hidden deep in a rubbish heap. The only conclusion I can draw from these circumstances is that they prefer fairly warm but damp situations below ground level. Such specimens of hibernating newts as I have encountered have been torpid, emaciated, and almost black in colour. I have never yet found the Great Warty Newt's winter retreat; but the two other species are in winter as dark as he is, with much the same distribution of orange. I have hitherto failed to keep alive any which I have once disturbed.

Should, however, hibernation pursue its normal course, and the newts once more reach the water successfully, they very quickly change their appearance. The male develops his crest, and the female, though she cannot rival her lord in beauty, is decidedly well turned out.

The male of the Smooth Newt is, in his wedding garment, the most brightly-coloured vertebrate we have. His back

FEMALE PALMATED NEWT USING HER TAIL FOR PREHENSION—A RATHER RARE OCCURRENCE.

and half his sides are a deep olive green spotted with black; the rest of his sides are yellowish, deepening on the under portion of him to a deep orange and also spotted with black. His throat is whitish. The under edge of his tail is crimson, the middle ultramarine; both parts are barred with black. The ridge of his festooned crest is tipped with carmine. In different individuals there is considerable variation, and the brilliance of the colours is undoubtedly influenced by his surroundings; but the above description may be taken as fairly typical of the male newt at his best. The female has little, if any, crest. Her colour scheme is olive, orange, and yellow, the two latter colours being confined to the under portions of her, and conspicuous on the tail where there are no black bars to break them. She also is sometimes spotted with black, but the spots tend to be smaller than in the male, and to run together in lines. In both sexes the skin is perfectly smooth, and—even when they are far from the water—moist.

The courtship of the male newt provides an entertaining spectacle. He directly faces the female, slowly waving his tail and rippling his crest, so that, if the lady of his choice has any sense of colour (it is difficult to see what meaning the brilliant colours have unless they can be definitely connected with sexual selection), she must be captivated. When this performance has been repeated before several females the male withdraws from the scene of conquest and deposits spermatophores in various places. These are subsequently seized by the females.

The eggs, which have a glutinous covering, are laid singly, and the female attaches each one to the edge of a flexible leaf of some suitable aquatic plant. She then folds the leaf back on itself, using her hind feet and mouth for the purpose, so that the egg, whose glutinous envelope seems sufficient to hold the folded leaf together, is completely hidden and safe from the attacks of small free-swimming enemies.

I have on one occasion seen a female swimming about with an egg "palmed" in her hind foot; but, as I have not observed this a second time, I fancy that the first leaf selected must for some reason have repelled the egg, and that this stuck to the newt's hind foot when she brought pressure to bear. Eventually she was compelled to find a more suitable leaf.

Given a supply of suitable weed (vernal starwort seems to suit her excellently), the female newt will continue laying for several days. Thirteen is the largest number of eggs which I have seen deposited by a single captive newt, but I have no doubt that under normal conditions this number would be largely exceeded. The egg within its leaf covering soon commences to swell, and matters can usually be so arranged that the development of the embryo can be easily watched. Perhaps the best arrangement is one

MALE OF THE PALMATED NEWT.
Showing the filament at the end of the tail.

1

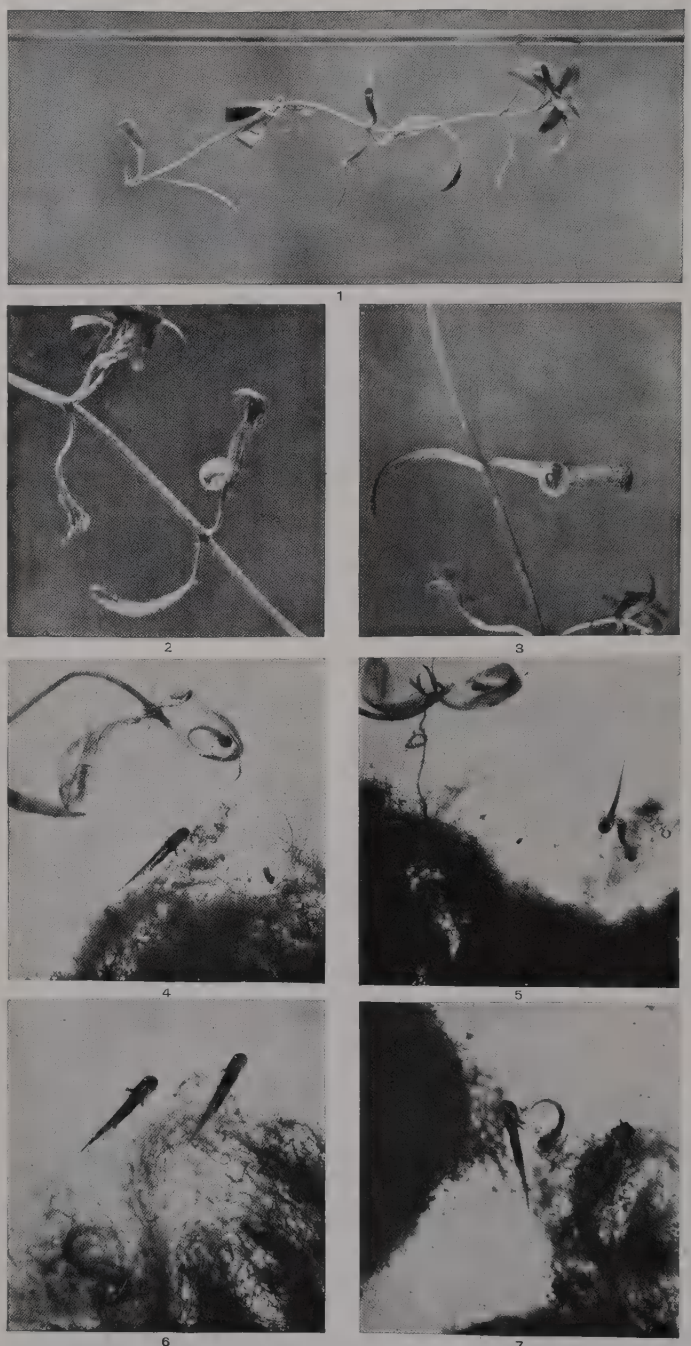
2

3

4

THE THREE BRITISH SPECIES OF NEWTS.

1, Male and Female of the Smooth Newt. 2, Male and Female of the Great Warty Newt.
3 and 4, Male and Female of the Palmated Newt.



SOME EARLY STAGES IN THE EVOLUTION OF THE NEWT.

1, Stalk of Vernal Starwort holding four Newt's eggs with the leaves bent back over them.
2, An early stage in the development of the Tadpole within the egg.
3, A later stage, the tail now plainly visible.
4, Tadpole immediately after hatching ; one still in the egg above it.
5, Dorsal view of Tadpole immediately after hatching.
6, Tadpoles two days old, the eyes and gills now evident.
7, Ventral view of Tadpole two days old ; one still in the egg on the right of it.

which permits of its being examined by transmitted light ; artificial light and a bull's-eye condenser sometimes prove useful.

The pressure outwards of the growing tadpole gradually opens out the leaf, so that observation tends daily to become more easy, and the development of head, gills, and tail can be clearly seen. The speed of development depends largely on the temperature of the water ; but under favourable conditions the tadpole bursts from his prison in about a week. Before he does this he is coiled up like a watch-spring, and may be seen at times to give a jerky movement in the egg. It is one of such movements that bursts the shell, whereupon he floats out into the water and sinks. At this stage he is to all intents and purposes a fish. He respires water by means of gills, he shows no sign of legs, and his tail is slightly finned above and below. Viewed sideways against the light, he appears to consist chiefly of two black parallel lines, the upper of which marks the ultimate position of his vertebral column, and the lower that of his digestive tract. Three blackish indentations at the head end of him show where his mouth and eyes will be. The whole of him is cased in a transparent filament.

In about two days his eyes become prominent owing to the appearance of a copper-coloured iris, and the upper black line is more easily distinguishable from the lower.

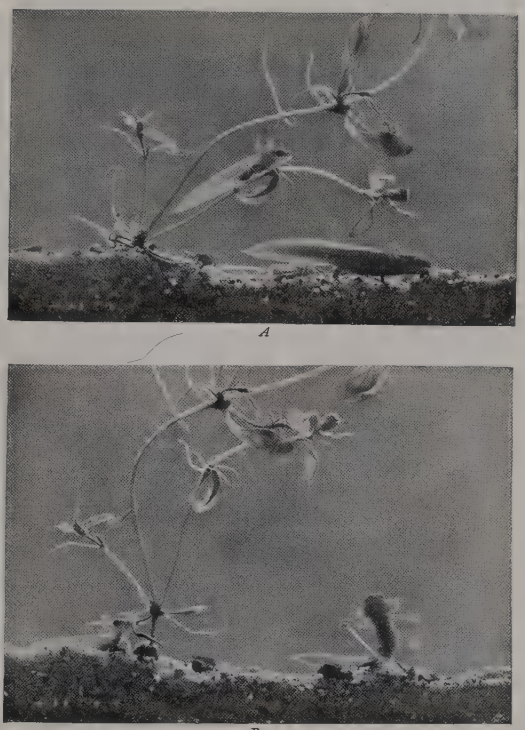
I have mentioned that the newt tadpole sinks on emergence from the egg, and I have little doubt that he naturally commences his free existence as a ground-feeder, sucking what suits him out of the ooze, and protected by his dark coloration until his tail becomes a serviceable swimming organ. One may often see very small newt tadpoles wriggle upwards in an aquarium, with much the same motion as a rising loach, and then fall back as if exhausted.

A fortnight after hatching, the newt tadpole has doubled in size, and, owing to the development of a transparent and shapely tail, which forms the greater portion of his length, is white rather than black. He now commences free swimming, and so transparent is he as a whole that only his eyes and the contents of his stomach distinguish him from his equally transparent surroundings. This transparency is evidently of a protective character, and he does well to remain on the bottom until it is acquired.

Free swimming seems to mean a change of diet; in place of a sucker he develops a mouth, and, I fancy, feeds on animalculæ, for he is continually hawking through the water, and when he comes to anchor on the vegetation, appears, unlike the frog and toad tadpoles, to be merely resting. Another interesting distinction from the latter is afforded by the order in which his limbs appear.

In newt tadpoles the front legs are the first to develop. Commencing as two small buds, they gradually lengthen into twigs, branch at the ends into fingers—first three and then four—and finally form remarkably skinny limbs, which are always held flexed at the middle joints. The adult newt swims entirely with his tail, and the strength of this member naturally increases as the newt tadpole grows. It is an evident advantage to have the first balancing limbs forward. In the case of frog and toad tadpoles the contrary happens. The tail gradually loses power, and the early growth of swimming hind-legs compensates for the loss.

Simultaneously with the growth of his limbs one can occasionally detect small bubbles of air from the newt tadpole's mouth, which show that his lungs are coming into being. From this point his gills begin to atrophy and he becomes less and less a fish and more and more an amphibian. His body shortens up, his limbs thicken, his skin loses its transparency, his gills disappear, and his gill-openings close. In three or four months, if all goes well with him, he is a perfected air-breathing newt. He now leaves the water, and it is practically certain that he does not return to it until his third or fourth year, when he is mature. As to what he does during the warm months which intervene, and as to how he lives, practically nothing is known, and much careful investigation is



A

B

Side view (*A*) and front view (*B*) of half-developed Tadpoles of the Smooth and Great Warty Newts. The Smooth Newt Tadpole is to the right in each case, and the feathery gills and developing limbs can be distinguished.

needed. Collections of small newts have occasionally been found at a considerable distance from water, which looks as if the

MALE SMOOTH NEWT WHO HAS LOST A CONSIDERABLE PART OF HIS TAIL.
The transparent portion shows the process of renewal about half completed.

year's brood travelled together, but I am not aware that such collections have ever been examined by observers who were competent to determine the maturity or otherwise of the newts composing them.

Of the age to which newts normally live nothing is known, but instances of remarkable longevity in captive specimens have been recorded. In *Country Side* of February 23rd, 1907, we read of a female of the Great Warty Newt who had been in the possession of her owner, Mr. P. Payne (Old Colwyn, North Wales), for thirty-one years, and who had presumably celebrated a silver wedding, for a male had lived twenty-five years with her.

The remarkable power which newts possess of repairing injuries to their tails and limbs, even to the extent of complete renewal, justifies our regarding them, from the assurance standpoint, as remarkably "good" lives.

The sloughing (periodical change of skin), which occurs regularly in both reptiles and amphibians, is especially interesting in the newts, owing to the dexterity with which they extricate their limbs.

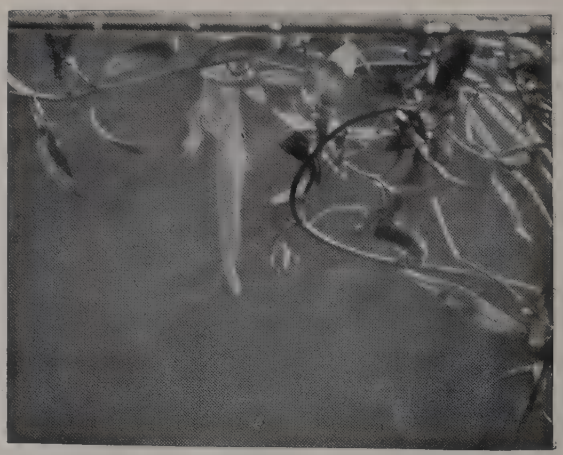
For some days previous to sloughing the newt seems peevish and ill at ease. The borders of his mouth become ragged, and one can see that the skin is peeling round it. He continually rubs himself against the weeds. Once, however, the preliminary stage is passed, it seems as though his whole integument came loose at once. He extricates his limbs one by one, and finally pushes his discarded garment backwards over his tail. Sometimes he eats it (the frequency with which certain reptiles, amphibians, and insects eat their exuvia is somewhat remarkable), but just as often the slough floats off behind him, forming a pretty, delicate object, and save for the inevitable tearing about the head portion, a perfect replica of his external form.

A few notes as to the means of distinguishing the three British species and as to their distribution may be of interest.

The Great Warty Newt is the largest of the three, averaging five inches in length and being stout in proportion. Next to him comes the Smooth Newt, averaging three and a half inches; and the smallest is the Palmated Newt, who averages two and a half inches.

The Great Warty Newt is known also as the Great Crested Newt, but the former name, which is derived from a distinctive character, seems the preferable one. It has its origin in the small warty protuberances with which his skin is studded.

The general colour scheme in both sexes is black and orange. The "black" may present an olive or brown tinge, while in



SMOOTH NEWT'S FRESHLY-DISCARDED SKIN SUSPENDED IN THE WATER.

the female the orange tends to be less intense. In both sexes the orange is confined to the lower portions of the body and tail, and is mottled with black markings. Along their sides is a scattering of small white spots. In the male during the breeding season the tail is banded with a wash of silvery grey, and the strongly serrated crest is not continuous from head to tail tip, as is the case with the Smooth Newt, but sharply divided where the tail joins the body.

The Palmated Newt, though of smaller size and quieter colouring than the Smooth Newt, is, nevertheless, a singularly handsome little amphibian. The usual orange waistcoat is there, but his beauty centres in the under-edging of his tail, which, though sometimes merely greyish, is more often tinged with an exquisite shade of lilac. In the female, as in the female Smooth Newt, the under-edging of the tail is yellow. The crest of the male Palmated Newt (it must be remembered that these descriptions are only applicable in the breeding season) is not nearly so well developed as that of the Smooth or of the Warty Newt, and instead of being festooned or serrated, presents a clean, smooth outline. The name, Palmated Newt, has its origin in the fact that the male's hind feet are well webbed (not merely lobed) in the breeding season, and another distinctive peculiarity of the species, also confined to the same period, is to be found in the termination of the tail. In the male the finned portion of the tail is rounded off abruptly, but the tail itself projects in the form of a black filament about a quarter of an inch in length. Traces of a filament can also be seen at the end of the female's tail, which, instead of being rounded off at the extremity, is triangular. The back of the female shows, as can be seen in the photograph on page 451, two keels running parallel to the crest. It is somewhat difficult for the novice to distinguish between the female of this species and the female of the Smooth Newt. Mr. Boulenger, however, has pointed out a criterion by which both sexes may be distinguished at all seasons of the year. This is the entire absence of pigment on the flesh-coloured throat.

So far as distribution is concerned, the Palmated Newt was, until quite recently, considered to be rare. The records of the British Museum, however, show that this view is hardly justified. So far as England, Scotland, and Wales are concerned (the Smooth Newt is the only one found in Ireland), the Palmated Newt has a wider distribution than either of the other two species, and in many localities he is the "common" newt.

Like the Sand Lizard, the Natterjack, and the Smooth Snake, the Palmated Newt is, in my experience, an inhabitant of heath country. I have proved, however, to my own satisfaction that "heath" is not essential to his well-being, by loosing some specimens from the Bournemouth district into the Darent Valley (Kent) where the "common" newt is the Smooth species. I released them about eight years back, and they now breed annually. I doubt if the reversed experiment of releasing Smooth Newts into heath country would be equally prosperous. The Great Newt seems to have a preference for clay soil. The ponds about brickfields are likely places in which to angle for him. His presence can best be determined by watching for the bubbles he makes when rising to breathe, and he can be taken with almost any bait, attached to a thread without any hook, but lightly shotted so that it may be cast by hand. He must be allowed to get a good grip of the bait, and may then be gently towed ashore. The two smaller species which frequent shallower water can easily be netted.

DOUGLAS ENGLISH.

Photograph by Pictorial Agency.

"A LITTLE WOOD WITH A WINDING PATH RUNNING THROUGH."
Battersea Park.

NATURE "IN TOWN"

IDYLLIC BATTERSEA

By ARTHUR SCAMMELL

A FREQUENTLY recurring dream visits the sleeping—not to say the more or less waking—hours of probably many Londoners, especially of those who are country bred. They dream that, walking the familiar streets, they turn a hitherto unknown corner, or find a gap where no gap should be, in a line of buildings, and there, in the heart of the City, they see a bit of real country—not a spacious, ornamental scene, but just a corner of still life, a homely matter such as would be passed by a hundred times in the country without admiration or regard. It may be a length of low blackthorn hedge with a few blossoms on the bare twigs, and a field of springing wheat beyond ; a corner of a rickyard with dusty straw littered about, a fragmentary hay-stack—the hay-knife left in a half-cut section—and a barn door standing ajar ; or a neglected orchard with crooked and leaning trees, tall cow parsley mingling with the drooping branches—a place possessed by shadows.

Through the following day the Londoner will be haunted by a sense of his dream, and will cast half-expectant glances down

obscure City turnings, and find himself regarding the infrequent City trees with a new interest, as though the dream scene lay concealed behind their leafy screens.

London is an old city, but not so old as the country; before the street was the tree, even as the tree will grow above its last ruins. Perhaps these visions of the night and fancies of the day are but retrospective or prospective glimpses; pictures flashing out through the darkness of time of the scenes which these spots of earth actually have presented or will present in other ages.

But in the present time and place the waking Londoner has not yet realised his dreams—not yet has he looked down the right turning; only in the imagination have they a local habitation and a name; and perhaps it is better so.

"Heard melodies are sweet, but those unheard are sweeter."

And yet, quite within its proper area, London holds some spots of quiet beauty, from which the graces have scarcely fled, where even that last sweetest odour of sanctity, the charm of solitude, may sometimes still be felt.

Less than two miles from Charing Cross there lies a little wood three acres in extent, and as wild as such a thing may be, with a winding path running through, overhung by trees of many kinds—oaks, elms, and ashes, planes, poplars white and black, with a dash of a wilder flavour given by some silver birches, two pine trees and a yew; beneath the trees are elder bushes, long grasses of many kinds, flowering nettles and burdocks six feet high; wild hyacinths grow there in the spring; and wood pigeons, blackbirds, and thrushes, with the blue-tit, the wren, and the robin, sing their songs, rear their young, and go their own lightsome way through life in that pleasant bird sanctuary.

Photograph by Pictorial Agency.

"IN THE MIDDLE OF THE WOOD IS A GARDEN."
Battersea Park.

In the middle of the wood is a clearing, and occupying the cleared space is a garden—a garden which melts away on one side into the freedom of the unfenced wood; and all around the trees make a noble hedge, a boundary broken into bays and promontories of summer green or wintry purple.

promenade entirely to one's self. Even the noise is softened by distance here, and early on Sunday mornings there is a great calm. Only one misses the hum of bees. With the wealth of flowers spread over this and other large park areas, one thinks that surely some of the enterprise and skill shown by the gardeners might be

Photograph by Pictorial Agency.

A LAKE VISTA, BATTERSEA PARK.

Straight paths traverse the garden, bordered by well-clipped box hedge: with plenty of elbow room, and with no attempt at a dazzling display, the beds are stocked with companies of old-fashioned flowers; and perhaps by the easy quiet grouping, perhaps because of the subdued light and abundance of shadow in the garden, the flowers seem to have a restful charm above other flowers: "They toil not, neither do they spin."

This pleasant, dream-like grove lies in the least frequented part of Battersea Park; the entrances at either end are agreeably obscure, so that very few of the many who visit the park ever enter it; and one may at certain hours, and always in rainy weather, have the leafy well directed to the pleasant art of bee-keeping.

The garden is not a public part of the park, but is reserved for the use of certain botanical students. When the gardening work is done, and at what hours the botanical students pursue their researches, is known doubtless to some, but the special charm of the place, to one who frequents it much, is its complete solitude. Nothing ever seems to be going on there except slow and silent plant growth; the flowers of to-day succeed those of yesterday, self-planted, self-tended—or do the fairies cultivate the garden at night? the gossamer elves amongst the blossoms, and the digging and carting done by the "drudging goblin," "the lubber fiend," who—

"To earn his cream bowl, duly set,
Will in one night, ere glimpse of morn,"

finish the task

"Which ten day labourers could not end."

Less than sixty years ago the site of Battersea Park was a squalid waste, the favourite scene for Sunday morning fights, whether of dogs, game cocks, or pugilists — a horrible example of the suburban wilderness.

THE LAKE, BATTERSEA PARK. *Photograph by Pictorial Agency.*

Old tales are told of deserts miraculously transformed by the divine power of music; the magic song of an Amphion or an Orpheus causing gracious trees and flowers to spring at once from the barren soil, softening the jagged rocks, and subduing the fierceness of brute beasts. But far away lies the land, and long gone by the age of these marvels, and "with other notes than to th' Orphean lyre" was this wilderness made to blossom as the rose. Years of hard thinking and half a century of hard work have gone to the making of it; and surely it is better so. The means have been as good as the end; the gardener, above all other men, will bear witness that "To travel hopefully is a better thing than to arrive, and the true success is to labour."

Though the realisation has only come about by slow degrees, it would be pleasant to suppose that the whole scene, as we have it to-day, and as those who follow will see it to-morrow, lived complete in the imagination of the designer; that with his mind's eye he saw the clouds of willow green that overhang the lake, and the arms of the white poplar lifted in the sunlight; that the elm tree avenues which he planted already cast their shadow upon his path; that he glanced down all these pleasant little vistas, and heard the birds already singing in the branches.

An artist is never satisfied; but surely this man, could he revisit the scene of his labours, would hardly say that his dreams had not been realised, that his well laid plots had gone agley. One little rift within the lute there would be, one error to deplore. With the view of obtaining a wider spread and a more con-

tinuous shade, the main avenue in the park was planted, not with the common elm, *Ulmus campestris*, but with the Dutch elm—a tree which throws its branches horizontally like the oak—with the unfortunate result that these long limbs, extended at the angle of greatest resistance, are unable to sustain their own weight; some have fallen, and many more have been cut off, disfiguring the trees, and giving, as scars are apt to do, a foothold for fungus and disease. To meet the difficulty, lines of healthy and well grown sapling planes have been planted behind the elms, destined in due time to replace them.

But life goes well with most of the trees; a dead branch is a rarity, the foliage is everywhere abundant, whilst the girth of many of the trees suggests a century's growth rather than the fifty years which, with a very few exceptions, is the limit of their age. The low level of the ground, and consequent immunity from damage by high winds, and the dampness of the soil (a dampness which is proved by the ease with which the lake is supplied from surface drainage only), no doubt favours tree culture; and it is only reasonable to expect that in time some very noble timber will be found here.

The walnuts have died out in Hyde Park, but in Battersea they still thrive—some of them older than the park. Amongst many varieties of the ash there are to be seen some particularly graceful specimens of *Fraxinus lentiscifolia* grafted upon the common ash, and curiously showing a much greater girth above than below the graft; a very clean and elegant tree is the Cornish elm, conical in shape, lofty, and with small bright leaves, much less liable, apparently, to damage from caterpillar and other pests than are the leaves of the hedgerow elm. Yews spread the darkness of their foliage and throw their darker shadows as naturally as upon a Surrey hill-side. Maples, especially the beautiful silver variety, flourish extremely. Perhaps, however, the waterside trees give the greatest pleasure, particularly the white poplars and willows and the Lombardy poplars that close some of the beautiful lake vistas.

One would like to speak of the birds of the park—of the coots and moorhens that run in the sedge, and make such pretty water groups in early summer with their families; of the thrushes and blackbirds that sing in the trees. One cock blackbird there is which shows the effect of human association and example by wearing a white collar, and many others, descendants probably of this civilised bird, have stray feathers of white. Robins, wrens, chaffinches, and blue-tits haunt the plantations; and the wood pigeon, now a naturalised Londoner, is everywhere.

At sunset there is a great muster of starlings, in restless flocks wheeling about their roosting places, settling for a moment and wheeling again, and all to that babel of chatter which is the starlings' lullaby.

It is difficult to understand, though it may half consciously be felt, how much these London parks stand for to London dwellers. Imagine a hollow of some vast and thirsty desert, filled with an expanse of veritable ocean; where the parched and wearied traveller might survey the stretch of sunlit blue, with the wild white horses coursing over the bar, and pools of cold sea water amongst the rocks; green swaying seaweed, "the sapless foliage of the ocean," growing in lucid depths; and ever flowing away, to mingle with the desert heat and dust, the tide of fresh sea air.

Equal in æsthetic value to many that live in London is the boon of the park. Ringed around with an interminable desert of streets, here is a little space held by the power that makes the world outside the city an ocean of living green. Though the leaves of the trees may be fouled with smoke, the rains will return and wash them clean. The grass, trampled and soiled, bathes itself in the nightly dew and sparkles to the morning sun in ever-renewed purity. Here tired eyes may take delight in bright colours of flowers, in infinite gradations of light and shade amongst the branches; in beauty of form and grace of motion; and above the distant noise of the traffic—a harmony overcoming a discord—tired ears may be soothed by the songs of birds, and the beloved sound of the wind in the trees.

ARTHUR SCAMMELL.

SNOWBOUND ANIMALS

By WALTER M. GALLICHAN

WHEN the blizzard sweeps the land, pursued by the cry of the fierce north-east wind, and the frozen snow, fine as sand, drifts on the hills and by the hedgerows, the wild quadrupeds and birds of our islands exhibit that intelligence which enables the fittest among them to survive the ravage of weather. The mountain hares of Scotland, and the ptarmigan, which thrive at all times in high altitudes, suffer less than any other species of our native fauna during a hard winter. But heavy snow and prolonged frost intensify the struggle for existence, even among these vigorous animals of the mountain tops, and in spells of severe weather they descend some distance down the slopes in quest of food and shelter.

Ptarmigan frequently bury themselves up to the neck in snow, leaving only their beaks exposed. Sometimes, when overcome by the cold and fatigue, the birds become torpid, and remain entirely covered by the snow for several days. When aroused by keen hunger they strive to force their way to the surface; but a number of ptarmigan perish from exhaustion in the exertion to gain the air through several feet of snow.

Red deer are singularly weatherwise, and when snow is threatening they come down from the hilltops and lie in the glens out of the force of the blast. In Devonshire, the descent of the deer from the high tablelands of Exmoor indicates to the farmers an advent of snow and frost. Like sheep in the snow, deer strive to maintain warmth by huddling together in the shelter of a bank or under the rocks, and the heat of their bodies often prevents the snow from freezing around them. A scanty picking of herbage may be found here and there in hollows and coverts, by scratching up the snow, and the shoots of underwood, moss, and leaves of evergreens provide meagre provender until the grass and heather shows above the mantle of white. Where there is a sufficiency of ivy in the woods, deer will defy starvation in the most rigorous of winters. Their hardships are, however, very severe when snow remains for several weeks upon the low-lying country; and at such times, though not often, deer will make a bold raid into the rick yards of homesteads, and feed upon hay.

Hares in snow-time often travel long distances to obtain food. They resort to the woods at the first sign of cold weather, and find shelter from the snow beneath thick brambles and holly bushes. Even after sharp frost there are still a few leaves on the bushes in the coverts, and these and the bark of young trees afford a diet in hard times. Hares will scratch deeply in the snow to find turnip or cabbage crops, and they make their way by night into gardens and nurseries where there are shrubs and herbaceous plants.

Rabbits fare better than hares when the earth is covered with snow, as they possess the shelter of warm burrows underground. By dint of questing and scratching, the coneys contrive to exist when many small birds are starving; but they have a keen struggle, and their flesh is soon reduced by spare feeding upon the bark of saplings and twigs of underwood. Rabbits are fortunate, in time of snow, if they can discover fields of swedes and turnips from which the roots were not lifted before the hard weather. Sheep are sometimes penned in these fields, and they soon thaw the snow by constant trampling. The rabbits will venture far from their burrows to forage in these root fields.

Foxes do not suffer much privation when snow is lying. They may be forced to change their hunting-grounds; but hares and rabbits, weakened by want, and rendered somewhat less wary than usual

by the necessity of finding food, often fall easy victims to the prowling fox. Pheasants, which are fed by hand in the coverts during a sharp winter, are especially exposed to danger from foxes; and the moorhens and wild ducks, that resort to the margins of flowing streams, frequently find their four-footed foe in wait for them amongst the rushes and osiers.

The hibernating squirrel and dormouse are usually well prepared for a bitter winter. Moles go down deep in the earth during keen frosts. Barn rats and house mice escape many of the trials of hard weather, for they flock to the ricks and the outbuildings of farms at the first approach of winter, and are seldom seen at a distance from the habitations of men.

Snow-bound birds endure sharper hunger and are more tormented by the grip of cold than the mammals. The redwings, fieldfares, and other visitants to this country leave the northern regions as soon as the temperature sinks. They fly southwards, and often find the reign of frost in other lands. The coming of fieldfares denotes the approach of snow and frost as surely as the barometer. Large flocks of these migrants resort to the central and southern districts of England, when arctic conditions drive them from their native countries. They arrive wearied from their long flight, and descend upon the waste of snow. In a few days the immigrants lose flesh, and become weak on the wing. They hunt for turnip fields, and feed amongst the pigeons and other birds. Many of them are seized by hawks.

The store of berries may have been plentiful in the autumn, but in protracted frost this fare runs short, and hosts of birds flit disconsolately over the whitened land, searching vainly for unfrozen marshes. Curlews and plovers wing their way slowly from shire to shire, uttering mournful cries. Starved and emaciated, they lose before long the power of flight, and creep about amongst the frozen sedge, striving to stir up insects from the adamant soil or thick coating of snow.

The shyest and wariest birds are tamed by the snow. Wild ducks, teal, and geese come within range of the gunner. At night, on the sea marshes, the air rings with the notes of lamenting wild-fowl. The receding tide leaves a strip of ooze on either side of the creeks, and here perchance the starving multitude may find a few small fish and scraps of food.

Snow spells suffering and tragedy for most feathered creatures. When the snow lies day after day, under a hard, blue sky, and the hardy ferns and even the gorse droop, many corpses of small birds are to be seen in the woodlands. The foot touches the frozen body of the delicately fashioned long-tailed titmouse, a little handful now of bone and feather. A dying blackbird emits a weak and piteous cry, as he hops feebly to the shelter of a bramble-bush. In the tree-tops the rooks caw dismally, as they survey the wide expanse of snowy country.

Around every farmyard, finches, linnets, and sparrows throng in search of grain and refuse from the kitchen. The birds are so enfeebled that they may almost be taken in the hand. If the kitchen door is left open, the robin will hop in and pick up the crumbs from the table. Scatter bread in the garden, and there will soon be a company of grateful guests. The chaffinches swoop down from the bushes, the blackbird pops out of the shrubbery, the pertinacious sparrows fight all-comers at the feast, and the jackdaw descends into the midst of the crowd. At roosting time the smaller birds cheep and twitter amongst the thick ivy upon the walls. It is here that they nested in the spring.

For the fowls of the air snow is the firmest lock upon the larder. Food in plenty lies beneath that crisp, gleaming coverlet of white, but the impenetrable depth of snow closes the storehouse. Snow-bound birds have scarce the heart to chirrup from the eaves when day breaks red in the east. They draw near to man, and seem to solicit his succour when Dame Nature deprives them of her sustenance. How gleefully the starving birds salute the breath of a south breeze! When the drops fall from the roofs, and the snow melts on the banks, there will be heard the bright note of the robin, the pæan of the thrush, and the piping of the blackbird, as though Spring had come to expel hoar Winter.

WALTER M. GALLICHAN.

THE COMMON ELM IN WINTER. (PARK-GROWN.)

Photographs by Henry Irving.

THE WYCH ELM IN WINTER.

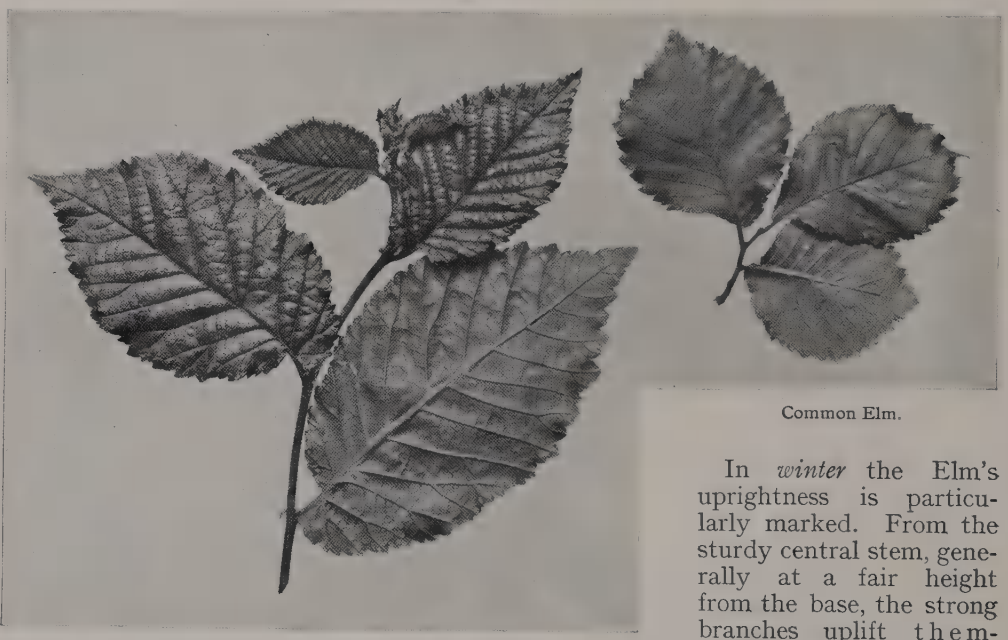
HOW TO KNOW THE TREES GROWING IN BRITAIN

With Notes, descriptive and photographic, for their Identification in all Seasons of the Year

By HENRY IRVING

THE ELMS

WE have two groups of these trees which find representation in the Common Elm and the Wych Elm. The Common Elm is most abundant in the Midlands and the South, the Wych Elm in the North and in Scotland. Tall-growing, holding themselves firmly erect, almost soldierly in bearing, sentinels of the plains, wardens of the fields, on guard about the farmsteads or beside the village green, their presence is always notable. Companionable among themselves, they choose the places of man's labour "under the sun." There they group themselves and thrive, but they cannot endure the town.



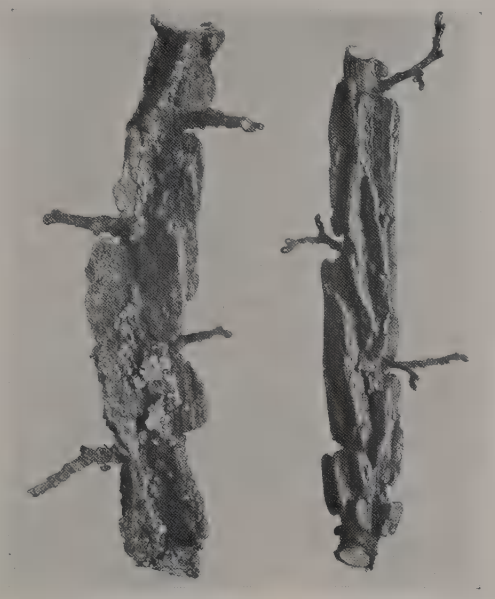
Wych Elm.
LEAVES OF THE ELMS.

Common Elm.

In *winter* the Elm's uprightness is particularly marked. From the sturdy central stem, generally at a fair height from the base, the strong branches uplift themselves, tapering gently to the furthermost twigs. The multitudinous crossings and interlacings of these terminal twigs enclose the tree in a closely set fringe as of finest filigree.

In *spring*, quite early, this outer fringe changes colour, deepens and reddens to a rosy glow that seems almost to emit light and warmth, a foretaste of more genial days, though yet the skies may

be grey and the air "has an edge upon it." For when the Elms are in flower the spring-time is fairly assured. Pre-



ELM TWIGS WITH CORKY BARK.

sently the glow fades, changing to a light and tender green. Clusters of winged fruits cover the surface as with foliage, though the leaves are still in hiding. Finally these unfold themselves and clothe the tree with delicate verdure.

In *summer* the foliage, now darker in hue, is richly massed. Sun-illumined surfaces gradating into deepest shadows present a roundness and fulness that give to this tree an especial "presence," powerful and well nourished. The shade it casts is wholly pleasant, and but little harmful to the grassy undergrowth, whereon the cattle rest through the hot hours of noon.

In *autumn* the Elm leaves retain their colour, but become gradually rusty-looking. Then a small patch here and there shows clear yellow. These patches increase and spread till the time of the fall, which is somewhat early.

The *bark* of the Elm is thick and often corky, roughened, and crumpled. In colour it is a medium grey. The *twigs* are greyish to brown. The *buds* are brown, conical in shape, and show several protecting scales. They are arranged alternately on the twig, and stand up on rather prominent leaf-bases, but always obliquely to these. The flower buds are larger and rounded. The *leaf-scar* is also prominent, approaching the circular in shape, and showing three distinct leaf-traces. The *leaves* must be considered separately, as these afford the best distinguishing marks. It may, however, be noted here that they have a somewhat lop-sided appearance, owing to the halves being unequal, as though on one side

Wych Elm. Common Elm, one with flower buds.

TWIGS OF THE ELMS.

of the midrib the leaf-extension had contracted, and shrunk upwards from the base. The leaf margins show large

teeth, which are again cut up into smaller ones.

The *flowers* grow in close clusters along the twigs—little rosettes of colour. Though small and without petals, yet clustered and massed they are effective, especially as they appear before the leaves. Each flower is both pollen-bearing and fruit-producing, with central stigmas and from four to six or eight encircling stamens, emerging from a tiny purple cup. The stigmas mature first and overtop the yet immature stamens. When the stamens are ripe and shed their pollen on the wind, the stigmas they now overtop have already received their needed pollen supply from elsewhere. So cross-fertilisation is provided for.

The *fruit* is in the form of a seed enclosed centrally, or nearly so, within a rounded flat envelope; thus winged, it is blown away and along by the wind, falling in showers, to cover the ground for some distance as with green confetti.

So far we have regarded points of similarity only; now distinctive differences may be noted.

RESTING BUD (ENLARGED) OF COMMON ELM.

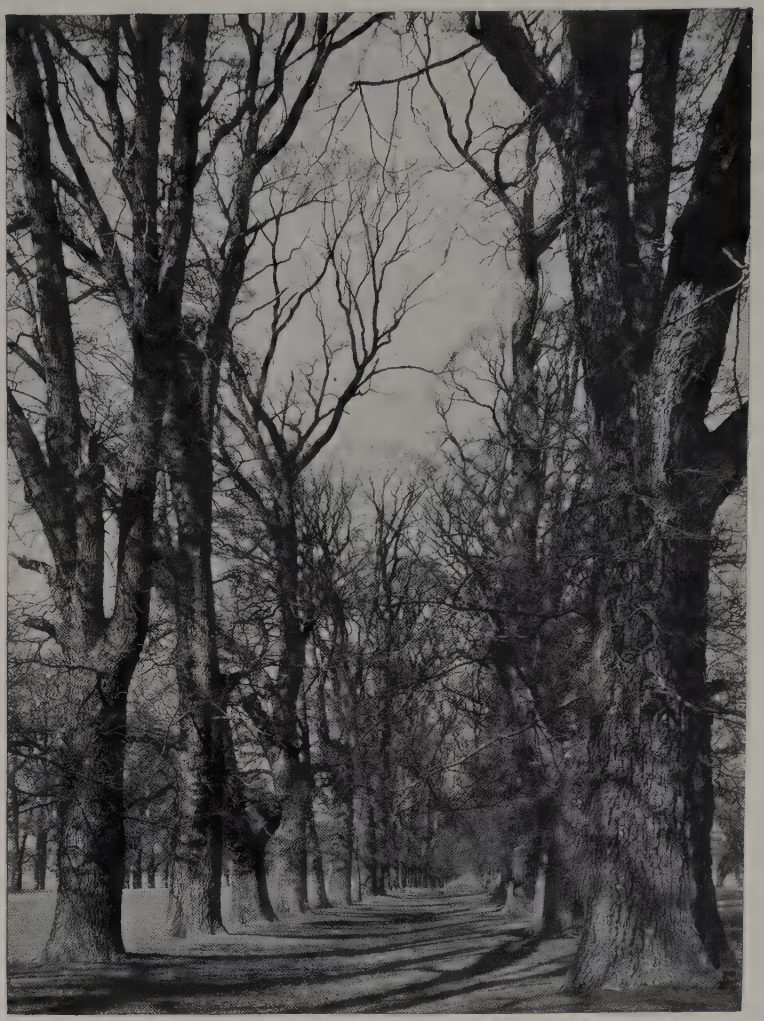
THE COMMON ELM

It stands up the more commandingly. Its great limbs reach upwards, and their terminal twigs curve forwards. Its *bark* is more deeply furrowed, more voluminously crumpled and folded. In one variety, the twigs show wide expansions of corky superfluous bark in ridges along their whole length, doubling and trebling their apparent thickness. One other tree—the Field Maple—has its twigs so thickened with excess of bark, but in a different fashion, as we shall see later. On the Elm twig these ridges of cork often stand out from the central axis in such a way as to suggest the blades of a ship's propeller.

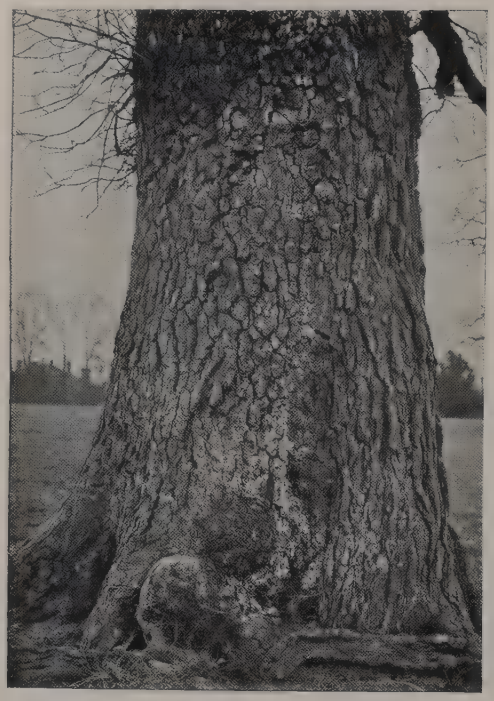
The *leaves*, on short stalks, are more or less rounded, with their widest part generally towards the base. The apex is drawn out into a short point. They are coarse in texture and tough, and owing to the presence of short stiff hairs are rough to the touch. The *flowers* are borne chiefly high up on the tree's crown. The *fruit* has its seed forward in the rounded envelope,

HOW THE LINE OF ELMS IS PRODUCED, AND A SUCCESSION IS SECURED (*see* p. 468).

THE COMMON ELM IN SUMMER.



THE AVENUE OF ELMS IN THE LONG WALK, WINDSOR



TRUNK AND BARK OF THE COMMON ELM.

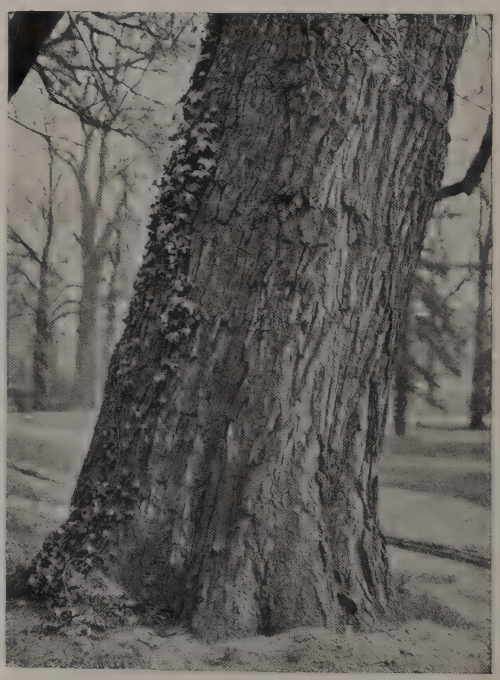
which is rather deeply notched. It falls early, and rarely, if ever, germinates.

In compensation for the lack of germinable fruit this tree has wonderful power of putting up strong root suckers. If a tree were securely fenced at the distance to which its roots extend, the enclosure would presently become a thick forest of young Elms. What really happens is that the suckers of unenclosed trees are destroyed, whilst still young, either by the plough or by grazing animals. But those that rise in the hedge bottom are protected. These, supported from the tree roots, grow strongly. If the hedge is regularly clipped it becomes, for some yards on either side of the tree's base, an Elm hedge only, for it entirely supplants what was there before and gave it protection. If the tree is cut or blown down the Elm hedge remains, witness that such tree once stood there. If the growing Elm hedge is left unclipped the stronger suckers take the lead. These kill off not only the hedge plants but their crowding neighbour suckers, and become young Elm trees growing in line. It is in this way that the line of Elm stalwarts is produced, and a succession is secured.

THE WYCH ELM

This tree has its branches more spreading. Its great limbs usually branch out from the stem at a lower level, and tend to droop at the extremities. This drooping tendency we see confirmed in the not infrequent specimens of "weeping" Wych Elms. Its *bark* is more regularly, less deeply, furrowed. Its *twigs* are never thickened with excessive growth of cork. Its *leaves*, practically without stalks, are larger, more oval in shape, and have their widest part more forward towards the apex, which is drawn out into a long point; their texture is coarser, they are more strongly ribbed, rougher to the touch above, softer beneath. The *flowers*, though most abundant high up, yet grow freely on the lower twigs also. The *fruit* has the seed more truly central in the rounded envelope, which is less deeply notched; it remains a considerable time on the tree, and some of it has germinating power. The Wych Elm has not found it necessary to specialise in root suckers.

HENRY IRVING.



TRUNK AND BARK OF THE WYCH ELM.

THE BEACH AT RAMSGATE.

From the Water-Colour Drawing by J. Buxton Knight in the Victoria and Albert Museum.

Photograph by Frith & Co., Reigate.

THE FIRST SPRINKLING OF SNOW.

THE GARDEN IN WINTER

By H. H. THOMAS

THE garden is the last place to which most of us would turn for enjoyment in the depth of winter; the cold, wet ground is unpleasant to the tread, the grass is damp and dank, and all that meets the superficial eye tends to promote depression. Yet the garden in winter is by no means as bad as it seems, but more than a passing glance is needed to discover its beauties. That winter has its own peculiar charm, even Cowper, most melancholy of poets, admits, for he says of this season:

> "I love thee, all unlovely as thou seemest,
> And dreaded as thou art."

As with our world, so with our garden, each is very much as we make it. A garden can scarcely be altogether void of interest in winter, neglect it how we may, and it ought to be full to overflowing of hidden joys and unsuspected beauties. The aspect of the garden is often, and more especially in winter, a reflex of ourselves or of the mood in which it finds us; a discontented mind fails to appreciate the subtle beauties of the leafless garden; these come home only to those of tranquil mood. The last two lines of an old song, quoted by Canon Ellacombe, might be offered as a passport to all who would fully enjoy their gardens in the dull season of the year. They may be aptly applied to the garden lover, since

they teach the need for a philosophic outlook on the world of leaves and flowers:

"But know the best season to laugh and to sing,
Is summer, is winter, is autumn, is spring."

There is much to enjoy in the garden in winter, even when a carpet of snow bright-toned blooms. But in winter, when trees and shrubs stand naked and only withered stalks mark the resting-place of flowering plants, the evergreens come to their own again, their value is undisputed, their attractiveness unchallenged. Their warm-toned leaves give

Photograph by E. J. Wallis, Kew Green.

"THE EVERGREENS STAND OUT STRONG AND DISTINCT IN A WORLD OF LEAFLESS TREES."

hides the bare, cold earth, and rime-covered twigs and shoots glitter and glisten in the pale sunlight as it filters through the clouded heavens. The evergreens then stand out strong and distinct in a world of leafless trees, while the berries of some glow with a strange brilliance that gains an added lustre in the dull, dim, wintry light. At this season the garden owes much of its attractiveness to evergreens, and it is only now that their true value is realised. In summer-time, when the garden is aglow with the varied tints of trees and shrubs, and the brilliance of blossoms, the evergreens pass unnoticed, save perhaps as a foil to some unusually cheeriness to the landscape, and the vivid contrast of bare trees around serves but to emphasize their charm.

The perfect garden has perpetual beauty, not only in the riot of summer bloom and frail spring blossom, but even in winter, when leaves have fallen and flowers are faded, and it must depend for its attractiveness on bright green leaves and brilliant berries. Then the most ordinary plants have a real value in the garden scheme, such for instance as Laurel and Privet, Aucuba and Barberry. These and others of higher degree help to make the garden pleasant in winter-time; they form indispensable links in the procession

"CHILLY, SMOTHERING SNOWS." *Photograph by J T Newman, Berkhampstead.*

of leaves and flowers that never fails, although it may falter. And how we should value these verdant links that weld the garden girdle in its weakest parts! Yet apart from their quality as firm forgers of a faltering chain, evergreens have an innate charm, an intrinsic value. Take, for instance, the Common Ivy, that will clothe a hundred ugly objects in the garden with persistent leaves, varying greatly in form and in shades of colour; some of the smaller-leaved Ivies have exquisitely carved foliage in most attractive colouring.

When to the merit of persisting leaves is added the charm of brilliant berries, then we have a plant of inestimable value in the garden in winter. Most common, yet perhaps most beautiful of all, is the Firethorn that covers countless houses with glossy leaves and glowing berries of orange and orange-red—berries that take on their richest colouring when sunlight wanes at the fall of the year.

Take, again, the Mountain Ash, that is happily more commonly planted in streets and roads nowadays; it is not evergreen, it is true, but how its red fruits glow in the winter sunshine! Then the Rock-sprays are quite a host in themselves, and the garden in winter could ill afford to lose them. They vary in size from the miniature Microphylla—that will creep along the ground as though filled with affection for the garden soil, or climb a low wall, while in winter it dapples its tiny leaves with crimson berries—to the favourite Simoni which grows six feet high or more, forming a big bush clothed in winter with bright red fruits. Other berry-bearing shrubs that give beauty to the winter garden are the Hollies—the red and the yellow berried; Aucuba, with green and with variegated leaves and scarlet fruits; the Partridge Berry, whose drooping white flowers in summer are followed by large red berries; the neglected Pernettya, a South American evergreen that bears most attractive berries in many shades of colour—purple, rose, pink, and white. These are plants to grow near the house, within full view of the windows. What even can the summer garden show more strikingly handsome than a large bush of the Sea Buckthorn, whose grey leaves themselves possess much quiet beauty, and in winter only peep out here and there between gorgeous yellow berries? The yellow-fruited Yew; the common Snowberry, so prolific of its large white berries; the Japanese Skimmia, a most cheerful little shrub with beautiful bright red fruits—these and the Strawberry Tree of Killarney, together with Mistletoe, are to the winter garden what gaudy flowers are to the garden in summer. The Strawberry Tree bears large fruits, quaintly described by Gerarde as "of a gallant red colour, in taste somewhat harsh, and in a manner without any relish, of which thrushes and blackbirds do feed in winter." The botanical name of the Strawberry Tree is *Arbutus Unedo*: the specific name *Unedo* is said to have been given for the reason that if you ate one you would certainly never eat another!

Just as most plants owe their charm to brilliant bloom and some to handsome leaves or fruits, so others are valued chiefly or solely on account of their beautiful stems, and these play an important part in the winter garden, of which they are rightly regarded as among the chief ornaments. Even from a distance, when massed in a large group, they strike a note of rich colour in the wan landscape. They are seen to greatest advantage when planted by the edge of pond or lake, so that the water surface may reflect their shadows when the pale gleams of winter sunshine reach them. Most striking of all plants distinguished by the beauty of their stems is the Moonlight Bramble, with gaunt prickly shoots that appear as though a limewash brush had passed over them; there is no more fascinating, if somewhat eerie, spot in the garden on a winter's night than where the Moonlight Bramble grows. Plant it in front of a group of Hollies, and an exquisite winter scene results. Attractive leaves, brilliant berries, and beautiful stems, are here—the three most valued characteristics of the winter garden. Some of the Willows and Dogwoods have finely coloured stems, bright red and glowing yellow.

There is rich beauty too in the reeds and grasses that cluster at the margin of the lake; frail and withered, yet graceful still, they flutter in the faintest wind,

swaying this way and that at the bidding of the keen-edged breeze. Sometimes there is nothing in the garden more delightful than Nature's wild disorder; this is true when her withered reeds and wizened sedges are silvered with the inimitable pencilling of frost and snow; then every branch and spikelet stands out in bold relief.

Even the common forest trees are in some respects most beautiful in winter-time, when the delicate tracery of branch and twig is outlined in exquisite silhouette against a blue-grey sky, and the giant trunk shows to the full its natural grace and symmetry. Many tree trunks are moss-grown and lichen-covered, and it is only when boughs are bare that Nature's wonderful tapestry, woven by the hand of Time, is exposed to view. Besides, each has its own characteristics—the Oak and Elm, Poplar and Chestnut, rugged with deep furrows; the Beech with smooth grey-purple bark; the Silver Birch, while showing to some extent the vigour of the forest trees, yet blends with this a matchless grace and perfect elegance that tell of the garden. Others equally common and some more rare have a beauty that is recognised only or chiefly in winter. Perhaps the most handsome of all our forest trees in winter is the Scots Fir, whose tall and rugged trunk takes on a rich orange shade. When touched by the dying glory of one of those ruddy sunsets that winter often gives, the warm colouring glows with an intense brilliance, until in strong silhouette against the darkening sky it throws a radiance round about that even the garden of high summer can seldom show.

Some trees have a certain strange and curious charm in the winter months from the fact that while their leaves fade they do not fall, but, withered and wizened by the buffetings of many storms, still cling with a desperation born of a great love for the tree that bore them, even when bursting buds and carolling birds respond to the call of spring. Even on wind-swept heights, exposed on all sides to the fury of the winter gales, one meets with the curious sight, in mid-winter and in spring, of a tree, scarcely in leaf, though certainly not leafless.

And the flowers of the winter garden? They are more numerous than one would think, yet some of them at any rate pass unnoticed since they are comparatively inconspicuous. Nevertheless they are well worth seeking out, for many of them have the saving grace of fragrance, without which a flower comes nearest to losing claim on the love and sympathy of the gardener. But it would be unpardonable to slight a winter flower simply because it lacked sweet fragrance; yet having this fair quality, must we not prize it the more highly? Earliest of all the winter flowers, perhaps, is the Jasmine, wreathing its slender leafy shoots with fragrant yellow blossoms that

> "Twinkle to the wintry moon,
> And cheer the ungenial day."

They make a delicate tracery on many a staring wall even before the old year passes to the new, and when winter fades to spring the Jasmine may still be found in bloom. Then there is the Winter Sweet—surely shrub was never more aptly named—which comes into blossom in the depth of winter with flowers that are delightfully fragrant. The Winter Sweet is accommodating to such an extent that one may grow it as a bush in the open garden or as a climber on a wall, but it is well worth while to give it the latter position, or there it comes earlier, and its flowers seem all the sweeter. The Witch Hazels are less commonly grown, and their flowers lack sweet scent, but this defect is almost compensated for by the exquisite crinkled blossoms in brown and gold that are freely produced on the spreading leafless shoots. No shrubbery can be without interest in the winter if the Witch Hazels find a home there—and they need the minimum of attention. Still less frequently met with, yet most striking when covering a wall, as it does without difficulty, is the Californian Garrya, an evergreen that bears gracefully drooping tufts of pale green catkins in early winter. Everyone knows the Mezereon—

> "Though leafless, well attired, and thick beset,
> With blushing wreaths, investing every spray,"

that smothers its stiff straight stems with little rosy flowers in late winter, flowers that exhale a rich fragrance that is de-

tected some yards away. The Japanese Quince, with its scarlet blossoms that show so well against a whitewashed wall; the winter flowering Honeysuckle—botanists rightly call it *Lonicera fragrantissima;* the Golden Bell Flower (*Forsythia*), the Dogwood, that smothers its branches with little yellow blossoms; the winter blooming Rhododendrons; Laurustinus that flowers practically the winter through; the common Mahonia, with broad glossy leaflets and cheerful yellow blossom; these and some of the Heaths are just a few of the flower treasures of the winter garden. For I have not written of the Winter Aconite, Hepaticas in red, white and blue, the little Cyclamen that loves the shelter of withered fern fronds, Snowdrops and Christmas Rose, about which many years ago *Punch* sang:

"A fiddlestick's end for the frost and snows,
Sing hey, sing ho! for the Christmas rose."

One of the great joys of a just appreciation of the garden in winter is found in the fact that throughout the so-called cheerless months one is not only enjoying to the full the subtle pleasure which the winter garden gives to those who care to seek her beauties, but one anticipates the coming of spring, and to the garden lover spring comes with the turn of the year.

Gardening has many pleasures, but perhaps the greatest of them all is that while the present always gives more than enough for perfect enjoyment, the bright future is ever uppermost in one's thoughts. This is of especial advantage in the depth of winter, for the deliberations of the gardener as he prepares for next year's flowers are full of the promise of spring, when once again Nature's smile shall spread to the uttermost corners of the garden, transforming the sleeping ground into a fairy carpet of living colour.

H. H. THOMAS.

IN THE GRIP OF WINTER. *Photograph by Frith & Co., Reigate.*

GRASSES OF THE HAY-FIELD

By MAUD U. CLARKE

With Photographs by HENRY IRVING

THE true Nature-lover who studies unconsciously, as it were, learning by a constant and never-to-be-satisfied interest in all the panorama of detail spread out before him, soon learns that Nature is wonderfully generous. There is a prodigal output, a munificent sum total of expressed forms, especially in the plant world. Not only quality, as supplied by the infinitely varied forms, but also quantity — unstinted quantity. Perhaps the grasses show this indomitable persistency of life, this immeasurable factor of quantity, the best of all. They show quality, diversity, beauty, a great range of expression, but the initial characteristic is this display of quantity in growth. If we think for a minute of all the grass fields, commons, turfy cliffs, and waste land that has covered itself with green in England alone, the grass seems to have made a big monopoly of space. And then we have to recognise that the credentials of the grass are great ones indeed, for it is granted as having certified habitat over "the whole world." Merely to reflect upon the uncountable quantity of grass blades in an ordinary two-acre field forces some recognition of what we owe Nature in a fractional space of the earth.

We could not easily spare our grass meadows, either from the point of view of utility, or from that of the subtle benefaction they give in sense of restfulness and healing. For those who value Nature in all its aspects, the grass land standing for hay in June is one that makes its special appeal to our sense of the beautiful and generous. A great gift is silently spread before us which even the meanest soul may feel in dim fashion.

MEADOW FOXTAIL.

Almost the first thing to strike our attention when considering the grass is the great pertinacity of life under persecution. Year after year the fields are either grazed down by cattle or shorn for hay when the grass is in full seeded strength; yet it never fails to renew itself. Apart from the care bestowed on cultivated grass land, the same energy of being is shown in neglected regions, where the grass triumphs over all sorts of ugly scars. The perennial root-stock seems to be the factor of inherited right to persist. If the flowering stems are all laid low there is left the root-energy to try again. If temperature is possible the flowers are rebuilt as quickly as can be; but after the wholesale slaughter of hay-making, when flowering stems and radical leaves are all swept down, time is not long enough to complete the effort before the winter cold temporarily checks ambition. The actual destruction of the seeded grass, unless required for harvesting the seed itself, is of little consequence

CRESTED DOGSTAIL.

on account of this perennial root-stock, and the seven species selected for illustration in this article all possess that characteristic.

The actual flower of the grass is an almost microscopic construction, and as far as general recognition goes, the term includes the whole collective outer casings of the flower known as the flowering *glumes*. They are concave bracts that protect a replica of the same idea of finer tissue, termed the *palea*, which in turn covers the minute flower itself. Many botanical distinctions are focussed on the varied forms or modifications of these usually unrecognised sections of the plant. As an average plan the flowering glumes are arranged either in spike formation, racemes, or loose panicles. The small spikelets collectively forming the spike are generally constructed of three or more bracts or scales—the lowest empty, the upper containing the tiny flower within the palea. It possesses two portions, or petals, a one-celled, one-ovuled seed-case with two or more feathery styles, and from two to six stamens. It is stated, however, with some sense of defeat, that classification among the grasses, owing to their great power of adaptability and consequent variation, is a difficult matter; they are regarded as a difficult family with which to treat.

CLUSTERED COCKSFOOT.

One further point in the construction of the flowering glume should be noted, as it adds so much to the general character of the whole spike or panicle in certain species. The glume possesses a midrib on the outer curve, and this may, or may not, ex-

MEADOW SOFT GRASS.

tend itself into a hair-like or bristly point, termed the *awn*. In the Barley and Bearded Wheat, we recognise the long bristly awn, whilst the soft down of many of the seeding grasses gives example of the other type of growth.

According to the temperature in the early weeks of our springs, so the rising and thickening of the grass varies in the meadows, for cold nights and late frosts can do much to delay the arrival of those neatly rolled sheaths that enclose the coming flower stem. It is always a pleasurable sight when one sees the fields changing in this way—the new order of things rising from the winter-worn radical blades.

But by the end of May and the arrival of June checks have been left behind, the grass is dense, and one of the familiar sights is the flower of the Meadow Foxtail (*Alopecurus pratensis*).

The beautiful golden-tan colour, or delicate mauve of the clustered anthers covering the spike, is as welcome as the "Cuckoo flower" amongst the grass. I have found that this colour-glow in the Foxtail flower is curiously evanescent; within an hour or two after gathering the stems it has faded to comparative dulness. Some very palpable alteration that takes place in the cellular formation mars the reception of light. The spikes vary from two to three inches in height, are rather blunt-headed, and carried on stems one to two feet high. The "keel" or midrib of the glumes extends as a hair, giving a soft character to the spike noticeable before the anthers are expanded upon it.

This species extends all over Europe and Russian Asia up to the Arctic regions, and flowers both in spring and summer.

The Clustered Cocksfoot (*Dactylis glomerata*) does more, for it flowers the whole season through. Right through the first snaps of frost in December I have seen it expanding its pale anthers in sheltered places in company with late efforts of the pink campion and other survivors of the plant world. It is a coarse, stiff grass of an average height of one to two feet, and forms the toughest section to the quality of the hay. The strong tufts often show a darker blue-green in contrast to the surrounding grass, whilst the blades, though pliant, are distinctly rough at the edges. In actual form the flowering head is rather variable; the illustration shows that of a spreading panicle, the general plan of which has

QUAKE GRASS.

given the name of Cocksfoot from the relative position of its divisions in respect of the stem as axis.

The spikelets are packed densely together, making an oval mass at the end of

CATSTAIL.

branchlets thrown from the stem. In colouring it is not so attractive as the Foxtail, yet the cinnamon anthers contrast prettily with the pale green of the glumes.

One of the grasses to accentuate that gleam and flash when the wind bends it in sunshine is the fine-stemmed Crested Dogstail (*Cynosurus cristatus*). The plant grows its radical blades in tufted thickness at the root, and sends up the wiry stems in competition with the neighbouring grasses, though sometimes they are less than a foot high. The fibre of them is distinctly tough and polished like glass. There is something of definite character in the way the clusters of glumes lie alternately right and left of the stem, giving the spike a flattened appearance. The stem itself bends to accommodate the clusters, making a zigzag line to the top of the spike—a length of one to three inches. With the exception of the blade elaborated from the sheath at the point where it opens to free the flower stem, the remainder are all radical.

The species is variable in its habitat, for although it has all the character of a grass belonging to high pastures, yet I have found it on the slopes of a water-meadow, albeit high on the slope. The passing of the water-flow over the roots was probably a different condition altogether from that where they would remain waterlogged in it. On the high land that is grazed during the year one is familiar with the fine fringe of fawn-coloured stems left standing in the autumn and winter months by this and other tough-fibred species.

Holcus lanatus is one of the commonest British grasses, and the common name of Meadow Soft Grass defines its principal characteristic. For the plant has a soft down overlying it throughout, which tinges the blades and stems and flowering panicles with silvery grey. The blue-green blades, velvety to the touch, have the midrib clearly expressed beneath them. In the early stage of growth the swollen sheath enclosing the coming flower has also the most beautifully soft clothing of fine downy hair. On first emerging, the spike shows a mass of silvery-green glumes delicately tipped with pink; as the panicle expands its spikelets this pink flushes the whole of the glume; and finally, as the grass advances to the dry stage, passes to the base, showing the tips now as light fawn-colour.

SWEET ANTHOXANTH.

The pink flush in a measure never quite deserts the cellular formation, for we are well acquainted with the masses of warm-toned dry grass all among the gorse of the

commons, edging quarries, and crowding in all sorts of odd places long after the hay-fields are bare and desolately green.

These dry, seeded grasses are frequently the haunt of small butterflies in the last warm weeks of the year, and no more charming surround for the little common blue butterfly or the orange of the small copper can be found than a mass of dry *Holcus lanatus* standing in afternoon sunshine.

In those days of burnt pastures and flower relics, the common Quake Grass (*Briza media*) is also to be found on the down-land and up-lying fields dried off towards extinction. But when established among the meadows it is early in the season, before outgrown by the taller species, that one comes upon it at its best. The exceedingly fine stems and branchlets, quivering at any breath of air or lightest touch of insect, have been every country child's plaything as naturally as the buttercups growing with the grass, so that everyone knows the look and name of this species, if none other. The neatly packed glumes that form the little shaking heads are beautifully coloured in alternate green and purple bands, and contain six to eight flowers, although the lowest pair are empty, and merely act as protective bracts to the whole group. When growing in down-land in short turf it becomes considerably dwarfed in height, and it rarely exceeds one foot in moister conditions. The blades are few except at the base of the plant, and it can scarcely be said to extend the bulk of the hay crop, although something may be gained in favour of the quality, since mixed grasses are of advantage. The Quake Grass, although spreading over much the same geographical area as those species already mentioned, does not penetrate so far north.

Another of the early summer grasses is the Catstail (*Phleum pratense*). In lush, moist ground it can run up as high as three feet, and produce a slim cylindrical spike six inches long, with a minimum length of one inch. There is a certain harshness in the feel of it, as the glumes have rough edges and bristly awns projecting from them, this harsh character being carried out at the edges of the blades. The coloured anthers are variably a cinnamon purple or yellowish, hung upon the pale green spike ; and there is a dark purple flecking on the outer edges of the glumes that adds quality to the general colour effect. This grass frequently flowers again in autumn ; and one of its haunts may be the shelter of the hedges surrounding the hay-fields. Here the long slim spike may be seen rising up through the sprays of dog-rose tangling among the Hedge Wound Wort, Angelica, Fool's Parsley, and many lesser plants. There is something in its general appearance that suggests the Sedges in character, although it is clearly severed from that family by definite botanical distinctions. In the central example of the group as shown in the illustration, the tightly-rolled sheath shows the slit opening on the side farthest from the expanded blade. Now this is the " hall-mark," or one of them, of the grass tribe proper, since the Sedges hold the sheath closed.

I cannot leave the hay-field grasses without mentioning the Sweet Anthoxanth (*Anthoxanthum odoratum*), for it gives the hay its sweetest scent—a slender and not very conspicuous addition to the height of the crop, yet certainly not a grass we could dispense with. As a perennial plant, blooming in spring, early summer, and autumn, it shows a valuable persistency of character that has no intention of becoming extinct short of atmospheric catastrophe.

One other species calls for brief notice as of much value in our town parks, lawns, etc., and that is the Annual Poa (*Poa annua*). It flowers nearly the whole of the year, and as an annual gets about its business with celerity, for the whole transformation, from germination to the seeding stage, is accomplished in a few weeks.

Where the edges of the turf have escaped shaving, or where fences give harbour, one sees the green panicle expanding itself in variable height from one-and-a-half to three inches. The meadow representative, *Poa pratensis*, is more imposing in appearance, the stem rising two feet and the panicle from two to four inches, but this variety only flowers in early summer.

MAUD U. CLARKE.

HOW TO KNOW THE AMPHIBIANS

By DOUGLAS ENGLISH, B.A., F.R.P.S.
Author of "Wee Tim'rous Beasties," "Beasties Courageous," etc.

THE FROGS AND TOADS

THE GRASS FROG. THE WATER FROG. THE COMMON TOAD.
THE NATTERJACK TOAD.

With Photographs by the Author

OUR tailless amphibians the Frogs and Toads belong to an Order which embraces some nine hundred species and has at present been divided into some sixteen families.

The main division separates those members of the Order which have visible tongues from those which have not.

THE GRASS FROG.
The characteristic marking behind the eye passes across the round tympanic membrane.

With the latter we need not concern ourselves, for none is indigenous to this country. The amphibians which are both tailless and tongued have been subdivided according to the structure of their shoulder-girdles, and one branch of this subdivision embraces our frogs, while the other embraces our toads. Of the two, the frogs are the most highly specialised—and the least intelligent.

British frogs can easily be distinguished from British toads by their external features. The frogs have smooth and moistened skins, the toads have dry skins covered with warts. The frogs have disproportionately long hind legs, the toads have legs in keeping with their bodies. The frogs have microscopic teeth fringing the upper jaw (these can be easily felt), and also on the roof of the mouth; the toads have no teeth. The frog's tongue is perceptibly notched, the toad's tongue is rounded. It must be remembered, however, that in a more comprehensive survey of the two families the above distinctions are not strictly applicable. There are toads with smooth skins, and toads with long hind legs. There are frogs without teeth, and frogs with unnotched tongues. As I have hinted, however, no frog is "arciferous," and no toad is "firmisternous."

Individual frogs and toads (of the same species) exhibit remarkable variations in colour, which depend to some extent on their surroundings, to some extent on the temperature and moisture of the air, to some extent on their sex, to some extent on the time of day, and to some extent on individual idiosyncrasies.

Generally, a Grass Frog's hind legs show transverse bars of some dark colour, and always, I think, he is lightest underneath. The back and sides of him may be plain or spotted, terra-cotta, orange-red, olive, yellow, green-brown or nearly black. The Water Frog is equally bewildering. He may have a conspicuous

THE WATER FROG.
The absence of the black marking behind the eye which distinguishes the Grass Frog should be noticed.

line down the middle of his back, or he may not. He may be bright green, or dirty brown; he may be both; he may be neither. Similarly with the toads. I have found terra-cotta, greenish, blackish and brownish specimens. The Natterjack is more distinctive, for the yellow stripe from the crown of his head down his back seems to be always present in British examples. His under surface is often white with black markings, and his upper surface one shade or another of yellow brown, often with terra-cotta blotchings.

Good reason for this infinite variety is to be found in the structure of the skins of tailless amphibians. The Grass Frog's skin may be taken as typical. In the superficial layers of this such pigment as appears is diffused and yellowish in colour. On the surface of the underlying portion (*derma*) there are layers of irregular and stellate cells containing a much darker pigment. In the living frog these cells contract, or expand, in response to sensory impressions from without, such impressions being conveyed to the frog's brain partly through the eye and partly through the skin itself.

A low temperature, for example, causes them to radiate pigmented branches outwards, so that the frog appears dark-coloured; a high temperature causes them to contract, so that the frog appears light-coloured.

Normally a frog's skin is damp and a toad's skin dry, though the latter becomes plentifully bedewed on occasion. In both cases the moisture is secreted by numerous and important glands, and the speed with which it can evaporate must depend on the humidity of the air, so that the latter no doubt has some influence on coloration. Both frogs and toads appear paler in the evening, but this may be due to the bodies forming a bright reflecting surface.

The Grass Frog adapts himself with great nicety to his natural surroundings. The fact, however, that when one wishes him to adapt himself to artificial surroundings he usually does not (and *vice versa*), shows either that we do not properly understand the conditions which stimulate his pigment cells, or that the frog knows his own business, and prefers to manage it his own way. The latter alternative implies that the colour-change is to some extent under the control of the frog.

A further interesting feature of his skin is that it forms a subsidiary breathing organ. During the subaquatic hibernation

THE COMMON TOAD.
The large parotid glands behind the eye, the warts on the body, and the webbing of the hind feet, should be noticed.

of frogs, in which period they are buried in the mud, or under stones, often with several feet of water above them, skin-respiration is a necessity. During his active period a frog breathes mainly, perhaps, by his lungs, but his skin, which is moist and delicate and richly supplied with venous blood, has the power of exchanging gases in such a way that he may be said to breathe by this also.

FRONT VIEW OF THE BREAST BONES (SHOULDER GIRDLE) OF (1) THE COMMON TOAD, (2) THE GRASS FROG.

That of the Common Toad is of the arciferous type, in which the bones and cartilages of the right side overlap those of the left. That of the Grass Frog is of the firmisternous type, in which the corresponding bones and cartilages meet in a straight line.

1. Clavicle.
2. Scapula.
3. Glenoid cavity where the arm bone articulates.
4. Coracoid.
5. Supra-Scapula.
6. Sternum.

The frog being common and easily captured, has had the misfortune to supply in himself the *corpus vile* for innumerable experiments. Frogs have been blinded to determine the reflex or voluntary character of their colour-change, and frogs have had their lungs removed to determine if they could breathe without them. The latter experiment showed that a frog deprived of his lungs can live and breathe for a considerable period. Let us hope that human curiosity is for once and all satisfied.

In addition to breathing by his lungs and external skin, the frog breathes by the mucous membrane of his mouth cavity. He may indeed be said to breathe with every part of him which is exposed to the external world. In certain tailed amphibians—the Italian *Salamandra perspicillata*, for example—not only are the gills suppressed in the course of development, but the lungs are suppressed also, and it is supposed that, in these cases, the mucous membrane of the mouth is the *chief* breathing organ.

Sufficient reason for the complex breathing in frogs and toads is supplied by the fact that they have neither ribs nor diaphragm. Their system of air supply must therefore be entirely different from our own. For a long time it was supposed that the intermittent pumping action in a frog's throat, accompanied by a pulsation (sometimes a heave) of the flanks, was the action which supplied a frog's lungs with air. Investigation has shown, however, that while this action takes place the glottis (entrance of the passage to the lungs) is closed, and that, consequently, the action is not directly connected with lung breathing. For a full explanation of a frog's breathing mechanism, and for a more detailed account of a frog's anatomy and life-history than it is possible to embrace in this article, I would refer the reader to Mr. O. H. Latter's excellent little book, " The Natural History of some Common Animals."

Like the newts, frogs and toads possess the power of regenerating lost appendages. Tadpoles of both species will quickly develop a new tail, or a new leg, to replace a lost one, and the power is not wholly lost in adults. Mr. Gadow gives an instance of this limb-renewal in the case of two Grass Frogs, each of whom had lost

THE NATTERJACK TOAD.

Distinguished by the yellow stripe down his back, the practical absence of webbing on his feet, and his mouse-like run.

a hand at the wrist. Within a year both had developed a four-cornered stump at the end of the clean-cut limb, and two of the protuberances developed subsequently to the length of four millimetres.

Again, like the newts, frogs and toads slough their skins every few weeks and devour them. Mr. Lionel Gilman, a very careful observer, has given me the following account of the process in the case of the toad: "I have often seen it stated that they take off their coats, roll them into a ball, and then swallow them. I have watched the process times out of number, and can only say that, in my experience, the skin is swallowed gradually as it is pulled off. The split is down the middle of the back, and the skin is pushed into the mouth on either side by the hands working alternately; the body meanwhile sweats profusely and is violently contorted at intervals."

THE MALE WATER FROG GAPING.
This action is noiseless.

THE MALE WATER FROG CROAKING.
The vocal sacs on either side are distended, and the mouth closed.

The eyes of frogs and toads are singularly beautiful. The metallic lustre of the iris (emerald specked with black in the Natterjack) contrasts boldly with the liquid depth of the pupil. In a bright light the latter contracts to a horizontal slit. Only the lower eyelid (nictitating membrane) winks, the upper is fixed to the eyeball. The eyeballs can be, and frequently are, retracted into the mouth cavity. With this muscular movement a wink of the eyelid is inseparably connected, and, as the retraction always takes place when frog or toad is endeavouring to cram a *bonne bouche*, the expression of the amphibian under such circumstances is highly diverting, and may be defined as "repletion tempered by remorse." Mr. Latter holds that the eyeballs (it must be remembered that there is no intervening bone between these and the mouth cavity) are forcibly retracted in order to help down the worm, or whatever the food may be.

The natural food of our frogs and toads consists of small live vertebrates, and the natural method of capture is the flick of a highly extensible and sticky tongue. This latter organ is fixed to the front part of the mouth, the free end of it lying back towards the eyes. In seizing a fly or other minute victim it is flung out to its full extent, and the tip of it curled downwards over the object aimed at, which is then whipped into the gullet. The action is instantaneous, and the success of it is assisted by the fact that each time the tongue shoots forward it carries with it some sticky mucus from the roof of the amphibian's mouth. With most frogs and toads it is essential that the prospective meal should show some signs of life, and, when it is of considerable size—a large worm, for instance,

or a baby of his own species—the frog or toad flings not only his tongue but himself. Having engulfed as much as his mouth will hold, he helps the remainder in with his hands.

Frog and toad tadpoles develop, like those of the newt, from eggs laid in the water. In the case of the frogs, each egg has a separate layer of mucus round

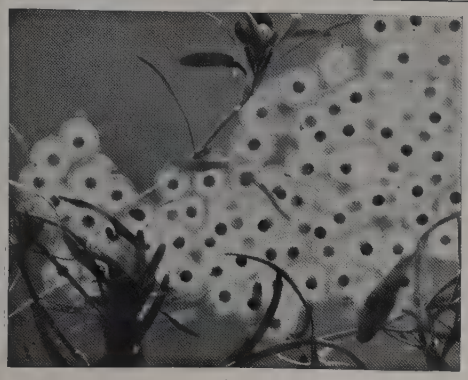
TOAD SPAWN, WHICH IS LAID IN ROPES OF MUCUS.

it; and a clutch of eggs, when the mucus has taken up as much water as it will hold, constitutes the familiar frog's-spawn. The Grass Frog lays from 1,000 to 2,000 eggs at a sitting, the Water Frog from 5,000 to 10,000, the Common Toad from 2,000 to 7,000, and the Natterjack from 3,000 to 4,000.* Toads expel their eggs in two ropes of mucus, which in the Common Toad are from ten to fifteen feet in length and in the Natterjack from five to six feet. The latter has the smallest tadpoles—about an inch long including their tails, and the Water Frog the largest—about two and a half inches long. The piebald eggs of the latter, however, are very small. The Grass Frog is the earliest to breed, then come the toads, and the Water Frog is last of all.

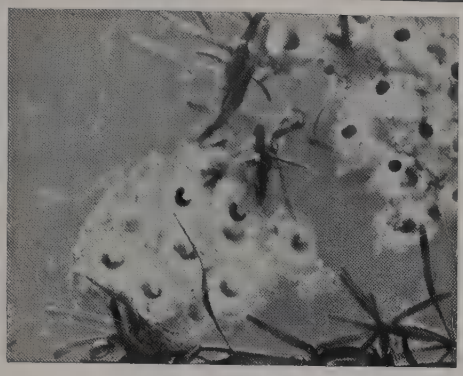
In the adult state our four British species are easily distinguishable, but it should be pointed out that the Water Frog (the name is preferable to Edible Frog, for the Grass Frog is equally succulent, though there is less of him), has rather a dubious claim to be considered indigenous. His claim, however, to be completely naturalised, on the ground of having bred in the same locality for upwards of seventy years and in other localities at intervals during the same period, can hardly be disputed. The variety *Lessonae* of the Water Frog (Mr. Boulenger recognises four distinct races) was first observed in the Fen districts about 1830, and is still abundant in Norfolk. About ten years back several Turkish specimens broke loose in the neighbourhood of my home in West Kent, and seemed to hold their ground for several seasons. In recent years, however, I have neither heard them, nor heard of them. The chase of the hibernating frog is so well organised in the immediate neighbourhood of the metropolis, that for a continental Water Frog to have a fair chance of survival he must be taken some distance afield; if possible to private ground, for his voice bewrays him, and the laboratories welcome him gladly.

The shape and size of the Water Frog are distinctive, and the most remarkable feature he possesses—the twin vocal sacs which bulge as he croaks with closed lips from slits on either side of his mouth—can be seen in the illustration on page 483. As a vocalist he is by far the most notable of our amphibians. His everyday note is a drawling quack, but his special love-song is the "*Brek-ek-ek-ek-ex—ko-ax, ko-ax*" of Aristophanes, which is familiar to every schoolboy. The first few notes of this are a preliminary sigh, the finale a pæan of satisfaction. Next to the Water Frog in song comes the Natterjack. He has only one vocal sac, deeply pigmented, and situated on the floor of his mouth. Air is forced into this through slits beneath his tongue, and the resultant melody is

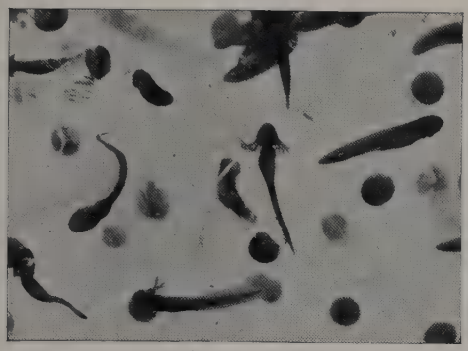
* Gadow.



1



2



3

4

5

6

SIX STAGES IN THE DEVELOPMENT OF THE GRASS FROG.

1. The spawn shortly after deposition ; each egg contained in an envelope of mucus.
2. The shape of some of the tadpoles distinguishable ; the mucus breaking up.
3. (Magnified). The branchiæ (gills) of some of the tadpoles visible. Those possessing them are now free in the mucus and feeding on it.
4. (Magnified). The gills and swimming tails well developed.
5. The gills atrophied. The tadpoles feeding on vegetation.
6. At the top of the picture is a four-legged frog tadpole, who will shortly leave the water, when his tail will be gradually absorbed. Next below is a black toad tadpole with rudimentary hind legs, resting on a frog tadpole with developed hind legs.

somewhat long-drawn. Mr. Latter has observed that the laugh of the woodpecker will start the Natterjack croaking, and that the note of a number in chorus can be heard across half a mile of country. In comparison with these two species the powers of the Common Toad and Grass Frog are feeble, though the latter's ability to produce a mysterious and muffled grunt under water seems peculiar to himself.

In swimming the frogs are, as might be expected from the development of their hind legs, markedly superior to the toads, and the Water Frog, who is essentially aquatic, and spends most of his time in the water, is the strongest swimmer of the four; while the Natterjack, who is essentially terrestrial, is the weakest. Both the frogs swim their fastest when they use their hind legs only and have their hands pressed close to their sides and pointing backwards. Both, however, can do a quiet breast stroke which is the envy of all human swimmers, and also a dog's paddle. Toads hold their hands pointing forwards and close to their heads. The Natterjack, all nip and bounce and sparkle ashore, is mightily humbled by a swim. He presses his hands palms outward to his cheeks, as though to hide his shame, swells out his stomach so that he is barely awash, and makes slow-measured but emphatic strokes with his hind legs. He reminds one of a portly old gentleman, who is conscientiously striving to improve.

THE COMMON TOAD FLOATING.
It should be noted that the mouth is below the surface and the nostrils above.

Feeble though his swimming is, the Natterjack can give his relatives a lesson in running. The frog's gait ashore is clumsy—or explosive. In walking or climbing the want of balance between his fore and hind limbs is all against him; he seldom, therefore, invokes these actions, but prefers either a prodigious bound, raising himself forward to begin with, so that his trajectory shall be high enough to clear immediate obstacles, or a protective mimicry attitude with his body flattened, his head tucked down, and his hands, palms outward, covering his eyes. Toads adopt a similar position, which reminds one of a child shielding its head from a blow. A captive frog jumps utterly at random, and appears so scared as neither to know, nor care, where he will land.

The Common Toad can hop in portly fashion, but his normal progress is a crawl—very different in outward effect from the leap of the frog or the flutter of the Natterjack; who, though the amount covered at each burst is seldom more than a foot, may fairly be said to run.

Superstition has for many centuries accredited the toad with venom and the power to use it, and superstition for once is right. The milky secretion on the skin of an excited amphibian, whether frog, toad, or newt, is unquestionably poisonous and protective. That a toad can in any sense spit venom is of course a fable, and it can only be under very exceptional circumstances that the poisonous secretion will affect a human being. An injection of it, however, is capable of killing small vertebrates, and care should be taken not to expose any abraded or delicate skin-surface to its toxic effect. The late Miss Ormerod was bold enough to bite a Great Warty Newt gently, and some alarming symptoms resulted. A curious accident once happened to myself in connection with the common European Fire-bellied Toad. I had been handling one freely, and shortly after replacing it in its cage felt a tickling in one of my

eyes, which I incautiously rubbed with my fingers. The result was such excruciating pain that for some minutes I was practically blinded. The subsequent inflammation of the affected eye lasted for forty-eight hours. Instances of the severe poisoning of the dog who worried the toad have been frequently recorded, and the dog who worries the frog is often sorry for himself. The fact, however, that many animals and birds seem to enjoy both species with impunity (though they usually satisfy themselves with their interior) seems to indicate that once the victim is engulfed the risk is trivial.

One can scarcely conclude an article on frogs and toads without a passing reference to toads entombed in solid rock. To discuss this question at length would be to insult the reader's intelligence. It may perhaps be pointed out, however, that ninety per cent. of the recorded instances could be effectually disposed of by anyone with a smattering of palæontology, and that the remaining ten per cent. could be disposed of by anyone with a smattering of common sense.

DOUGLAS ENGLISH.

HOW TO KNOW THE TREES GROWING IN BRITAIN

With Notes, descriptive and photographic, for their Identification in all Seasons of the Year

By HENRY IRVING

THE ASH

IN the Ash loftiness and strength are suffused with beauty and grace. Ruskin says there is no lovelier tree in the world. She has no rival. In the hedgerow, in the open meadow-land, on the hill slopes, she maintains a natural apartness, in all simplicity and nobility of demeanour, as of one whose primacy is native and assured. Dainty is the Birch as a girl of "sweet seventeen"; diaphanous gauze is her attire, and the rhythm in her every movement is as the play of the dancer's limbs and feet. Stately and mature is the Ash; hers is raiment as of fine needlework, and she wears a jewelled crown. She shall be Queen of the Summer.

In *winter* the natural stateliness of the Ash is best realised. The main stem rising, often without division, high towards the summit displays great firmness of line, strong without heaviness, as a column of steel, fitly proportioned to the weight of the superstructure. Each limb, or arm, rising and extending in pure unencumbered curves, shows a like blending of firmly girt power and resilience. These several curves of each limb are merged into the larger curve and onward flow of the whole, as it sweeps outward towards the tree's margin, where it dips for a space, then lifts itself upwards, bearing its grouped twigs like the balanced branchings of a series of candelabra. And there at the extremities, if the tree has fruited, droop those distinctive clusters of "keys," which, even in the modified sunshine of winter, still maintain something of the lustre that was theirs amidst the glowing lights of the autumn.

In *spring*, when most other trees have broken, or are breaking, into leaf, the Ash, blossoming all over, first "adorneth herself with her jewels," glistening as with ruby and amethyst. Later the feathered leaves spread out their soft greenery, gracefully drooping, overlapping and interlacing, forming flounces and fringes; but then the full summer is here.

TRUNK AND BARK OF THE ASH.

In *summer*, if we would enter into the serene joy of this Queen of the Summer, we must get within the range of her shadow. It is good, in the heat of the day, to lie there on one's back and watch, as one may without tedium, the blue of the sky as it ripples and drips in and among the pervading green translucency, merging, vanishing, and reappearing, making and breaking infinite patterns of changing light and colour, as the wind swaying the branches gently tests the delicate poise of the leafage.

In *autumn* the lightly-coloured clusters of full-grown "keys" early assert themselves, hanging, pendent like ordered ornament, amidst the mature green of the foliage. These change to yellow and bronze, until presently they predominate, shining with metallic lustre as of hammered copper or beaten gold. But not all the trees, nor always the same trees year by year, make thus their final display. The Ash, slow in the spring to robe herself in green, is amongst the earliest to disrobe in the autumn.

The *bole* is firmly cylindrical, knit together, hard and strong. The *bark*, but moderately roughened with orderly fissures, is light grey in colour, rendered often silvery by abundance of clinging lichen. The *winter twigs* are stout and smooth, curved, compressed and flattened where the buds emerge, and strengthened with side-stays to support the coming leafage, which will be large and weighty. The *resting buds* are velvety black, in strong contrast with the greenish grey twigs, on which they are borne in opposite pairs. The *leaf-scars* are large and prominent, nearly circular in outline, within which, and parallel thereto, the leaf-traces, merged together, form a strap-like curve.

The *leaves* are compound, like those of

COMPOUND LEAF OF THE ASH.

THE ASH IN WINTER.

THE ASH IN SUMMER.

the walnut; they comprise from two to six pairs of leaflets, with a single terminal one. This subdivision of large leaves into leaflets on several of our trees has arisen from the necessity to reduce the strain caused by wind pressure, and in avoidance of rending and breaking. Each leaflet, attached usually without stalk to the side of the extended midrib, is a long oval, pointed at both ends, sharply at the apex. It is thin and smooth in texture. Its margin is irregularly toothed. The terminal leaflet is largest, and each several pair of leaflets beneath shows a gradual diminution. The main midrib is channelled on the upper surface, as is the leaf-stalk, which broadens at the base, partly enclosing, as if for protection, the young new bud. In autumn the leaflets often fall separately, leaving stalk and midrib to fall later.

WINTER TWIG OF THE ASH.

The *flowers*, which grow out from beneath the as yet unopened buds, form mossy clusters of a ruddy purple colour. Though without petals, they are very conspicuous on the leafless twigs. Normally each flower of the cluster is complete, having two stamens and a flask-shaped pistil with two stigmas. As with the Elms, these stigmas mature first, so that what pollen reaches them comes carried by the wind, from the stamens of more forward flowers. But there is great indeterminateness as to character in the flowers of the Ash. In some are stamens that fail to develop; in others the stigmas are absent. Some branches —and, indeed, some trees—have only incomplete flowers of one kind or the other, and these are said to vary also from year to year. The flowers of the Ash are evidently in process of transition, and the problems involved are of special interest. The reader may here be referred to the account of these given by Dr. Groom in "Trees and their Life Histories." (Cassell & Co.)

RESTING BUD (ENLARGED) OF THE ASH.

The *fruit* consists, like that of the Elms, of a seed (or nut) enclosed in a flat envelope, which, when the need arises, serves the purpose of a wing. This wing is long and narrow, and has often a twist like the blade of a ship's screw. The seed is at the base, close to the footstalk. The fruit clings firmly to the twig through most of the winter, till the attachment becomes weakened, weather-worn. It is then torn away by the first strong wind and carried afar. It alights seed downwards, and the screw-twist, which, when present, has probably aided its farther flight, may now serve to facilitate the seed's entry into a suitable crevice, or into the soil itself.

As with the Wych Elm, so with the Ash, there is a drooping (or "weeping") variety of frequent occurrence.

HENRY IRVING.

HOW TO KNOW THE INSECTS

By JOHN J. WARD, F.E.S.

Author of "Life Histories of Familiar Plants," "Some Nature Biographies," etc.

THE "WOOD WASP" AND SOME AUTUMN INSECTS

With Photographs by the Author

NOT long ago a shopkeeper of my acquaintance sent an urgent message for my assistance. On entering his shop in the morning he had found it in possession of several "hornets"; how they got there he did not know, but they were buzzing about the place in a very alarming manner. The remarkable part of the story was that, although he had killed three that were flying in the early morning, later in the day others were still appearing, and he had arrived at the conclusion that they must have a nest somewhere in his shop.

Now, a nest of hornets in a grocer's shop is an aspect of insect life that calls for immediate attention; therefore I proceeded at once to investigate the matter.

On my arrival the insects were very lively. They were buzzing noisily about the shop, and the grocer was in a state of panic. He was, therefore, considerably astonished when I captured one of his "hornets" from the window with my bare hand. Only a glance was needed to recognise the insects as the Giant Sirex, or "Wood Wasp" (*Sirex gigas*), as it is familiarly termed, an example of which is shown in the first illustration. The popular name is, however, misleading, as the insect is not a wasp, but a Saw-fly.

In some seasons these insects are very abundant, and at such times I frequently receive boxes labelled "Open with care. Live Hornet," but almost invariably these turn out to contain specimens of the Giant Sirex.

The black and yellow banded body and yellow legs, together with its hornet-like flight, doubtless account for the frequent mistakes made with regard to this insect. The body of a hornet is much stouter than that of the Giant Sirex, and its markings are of a red-brown colour, not nearly so yellow as those of the Sirex. On page 492

THE GIANT SIREX, OR "WOOD WASP."

some hornets are shown—the male uppermost, the queen in the centre, and the worker, or imperfect female, lowermost. Only a glance at these insects is needed to see how different they are from the Sirex; indeed, hornets are simply a species of large wasp.

The conspicuous "sting" (often an inch in length), is not the least terrifying part of the Sirex. In the illustration

on page 491 it is seen extending beyond the short blunt tail at the end of the abdomen. This instrument readily distinguishes the insect from a hornet, for the sting of

HORNETS.
1. Male. 2. Queen. 3. Worker.

the latter is no more conspicuous than that of a wasp. Furthermore, while the sting of a hornet is a thing to be carefully avoided, that of the Sirex need not be feared. Indeed, it is not a sting at all, but a complex boring instrument in a two-fold sheath. The head of the borer is provided with sharp, curved teeth, which penetrate the bark and wood of fir trees. A hole is then drilled by the borer, and within the hole the insect deposits her eggs. When egg-depositing these insects may be easily captured, for the withdrawing of the long ovipositor is a slow process, and if the insect is removed suddenly the ovipositor will be broken off. The male insect, of course, does not possess this organ, and, consequently, more closely resembles a hornet.

From the eggs so deposited come whitish maggots or grubs which bore their way into the solid wood of the tree, eating out tunnels with their strong jaws in all directions. The grubs often feed for three years within the tree, eventually becoming chrysalides near the openings of the tunnels. The flies appear from the middle of July to the end of November.

Sometimes, for some reason, they remain in the chrysalis stage for long periods, and if the infested tree should then be felled, and the wood used for household purposes, trouble often arises. Such, indeed, was the cause of the invasion of the grocer's shop referred to. As I suspected, he had recently had some new woodwork put into his premises, and that was the origin of his "hornets' nest." The time had arrived when the insects should appear, and that they were then located in a grocer's shop did not alter that fact in the least; the round holes from which they had worked their way out were visible in the woodwork to prove plainly whence they came.

In the illustration on page 493 are shown two examples of the Poplar Hawk-Moth in their larval or caterpillar stage. (The moth itself I have described in a previous contribution, and illustrated on page 212.) This larva is familiar in autumn as it crawls down the trunks of trees, or about the surface of the ground; for at that period the caterpillar is full-fed, and then leaves the tree to bury itself beneath the soil, where it will mould an oval-shaped chamber, in which it will moult its skin and become a chrysalis. So it remains until May of the following year, when it leaves the cavity in the earth, and works its way to the surface again. When it appears, it is no longer a caterpillar, nor is it a chrysalis, for it has completed its metamorphoses and become a moth. At first it looks a quaint object, all legs and body, as it climbs the stem of a plant, or perhaps the bark of the tree on which it fed as a hungry caterpillar, but an hour later its wings have fully developed in all their wondrous hues; the moth then appears as shown in the illustration on page 212.

The photograph shows well the distinguishing features of the caterpillar. Its body

is rough and of a green colour, sprinkled with minute yellow spots. Seven oblique yellow stripes appear on each side of the body, which fade into the general green colour on the back, as seen in the example on the right of the illustration ; the horn at the tail is of a yellow colour shaded with brown.

This caterpillar may be easily mistaken for that of the Lime Hawk-Moth (which moth was illustrated on page 72), as their colours are very much alike. The larva of the Lime Hawk-Moth, however, has the oblique yellow stripes tinged with pink or purple, and the horn at the tail is blue above and yellow beneath ; also, when full grown, its body is more slim than that of the Poplar Hawk-Moth. Then there is the Privet Hawk-Moth (illustrated on page 213), the larva of which is very similar in shape to both the foregoing, but much larger—sometimes three inches in length—and its body is smooth, while the oblique stripes are white, edged in front with purple, and the tail horn is black above and yellow below.

It will be seen, therefore, that the larvæ of the familiar Hawk-Moths bear some general resemblance to each other; there are other similar species that may occasionally be met with, but their general shape, striking colours, and the horn at the tail serve to distinguish them as Hawk-Moth larvæ.

Perhaps I had better add that the tail of these larvæ need not be feared. What function that organ serves is a matter upon which naturalists have not yet decided. Nevertheless, an unfamiliar animal, possessing at its tail a horn that looks as if it could sting, always commands respect. Besides, when these caterpillars are resting amongst the leaves after feeding if one is disturbed it immediately begins to wave its head from side to side in an angry fashion that plainly shows its annoyance, and at the same time gives the impression that it really intends to protect itself if touched again. This threatening attitude, combined with a tail that seems to bear a stinging weapon, probably deters its assailants from further attacks ; indeed, I have seen many human assailants very much alarmed by the movements of these caterpillars ; nevertheless, their defence is simply bluff,

CATERPILLARS OF THE POPLAR HAWK-MOTH.

for they have no real weapons, and are quite harmless.

At about the end of July the handsome Peacock Butterfly (*Vanessa Io*) again appears, and from thence until late autumn it may be seen feasting amongst the thistle heads, and also in the gardens and orchards, for ripe fruit has a great attraction for it. Its reddish-brown wings with their conspicuous "peacock eyes" readily distinguish it. The butterflies that appear in July are the offspring of those seen in the spring, for, at the approach of cold weather, they hibernate for the winter, and reappear in the spring to deposit their eggs.

The eggs are usually placed in batches amongst nettles, and from each batch appears a host of caterpillars which feed gregariously, and eventually appear as a

PEACOCK BUTTERFLY.

black mass amongst the leaves. Later on, when full-grown, they separate, each one selecting a suitable site beneath a leaf or stem to which it can suspend itself by its tail-end to become a chrysalis. Attached to a little pad of silk, which it spins, the caterpillar remains for about three days, then it moults its black and spiny skin, and becomes a green chrysalis like that

CHRYSALIS OF THE PEACOCK BUTTERFLY.

shown above. At the end of nine or ten days the chrysalis suddenly bursts open, and the butterfly appears.

On pp. 73 and 74 of the "Nature Book" I described and illustrated the development of the Pale Tussock Moth from its chrysalis, and it was there shown that some fifteen minutes or more were required for its wings to become extended. But with butterflies this is a much more rapid process. Instead of taking fifteen minutes or more, the wings are often extended in that number of seconds. The emergence of a butterfly from its chrysalis, and the development of its wings, is a sight which once seen can never be forgotten, and one that every Nature lover should witness; the whole process is a marvellously beautiful and engrossing transformation.

The chrysalis hangs suspended as shown above, but just when the butterfly will appear it is impossible to foretell. This uncertainty, therefore, necessitates a constant watch, for only five seconds of divided attention may mean that the emergence will not be witnessed; since during that short period of time the butterfly may free itself from its chrysalis.

The chrysalis at the moment of bursting.

Five seconds later.

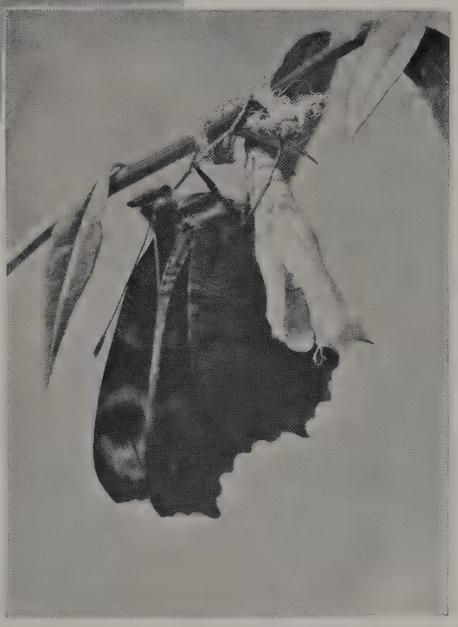
Knowing the difficulty which the busy Nature lover has in maintaining such an uninterrupted watch, I have endeavoured to record, by means of the camera, an actual emergence of the Peacock Butterfly—a task that involves no little trouble and care, as any who will try the experiment may prove.

On page 494 the chrysalis is shown as it hung for eight days. On the ninth day it had changed colour very considerably. The butterfly was so far advanced in its development that its coloured wings showed through the transparent chrysalis skin. Near midday, without the slightest warning, the chrysalis suddenly burst open and the butterfly literally tumbled out head downwards. The chrysalis is shown above at the moment of bursting. Five seconds later it appeared as shown in the centre. Just as one expected to see the butterfly fall to the ground, it was seen to be clinging to the empty chrysalis skin, for it instantly grasped the stem with its long, second pair of legs. At that moment it was a most dejected looking object, but ten seconds later it had fully extended its wings as shown in the final photograph.

Although extended, the wings were not ready for flight, but were soft and limp. Twenty minutes later, however, they had dried and become under muscular control, and the insect opened them and exposed the velvety sheen of their surface to the sunlight, revealing a display of lovely colours—reds, browns, yellows, greys, and black all beautifully blended—while four bright blue "eyes" almost dazzled the gaze as they caught the sunlight.

Only some two weeks before this exquisitely adorned insect was an uninviting, black, spiny caterpillar, devouring nettle leaves with astonishing rapidity; where and how it acquired its wings so gorgeously painted, in the brief chrysalis period, is a secret hidden deep within Nature's book.

JOHN J. WARD.



Fifteen seconds after emergence from the chrysalis.

THE DEVELOPMENT OF THE PEACOCK BUTTERFLY.

WHERE SALMON TROUT START FROM THE SEA.

BRITISH FRESH-WATER FISH AND THEIR HAUNTS

By WALTER M. GALLICHAN

With Photographs by Mrs. C. G. GALLICHAN

THE SALMON TROUT

THERE are so many points of resemblance in the Salmon Trout to the salmon, in structure, appearance and habits, that the uninstructed eye is apt to mistake these two members of the Salmo family. A Salmon Trout of five or six pounds is not very different at a first glance from a small salmon, and it is only when certain markings and some variation in shape are indicated that the difference can be seen between *salmo trutta*, the Sea Trout, and *salmo salar*, the salmon.

I think it would be well if we described this fish always as the Sea Trout, to distinguish it from the salmon and the brown river trout. Sea Trout, or Salmon Trout, are the companions of the salmon in their migrations, and they are taken in the salmon nets in the estuaries of rivers, while in some parts of the country they are sold and eaten as "salmon"; but the Sea Trout never grows into a salmon, though there are country folk who believe that this development is a natural one.

The Sea Trout, like the salmon, breeds in fresh water, and spends some months of each year in the salt sea. It begins to ascend the streams in the spring, in a few parts of the kingdom; but the usual time for a "big run" of these fish is from midsummer to the end of October or mid-November. In the rivers of Dumfriesshire and Galloway, the bigger Sea Trout begin their migration from the bays in June, and this run is followed by an advent of the smaller nomadic trout from the sea, known locally as "herlings." A herling weighs from half a pound to a pound, and a Sea Trout from a pound up to several pounds. In the Highlands the smaller Sea Trout are called "fin-

nocks," and in the west of England the Salmon Trout goes by the name of "peal" or "peel." A Sea Trout in Ireland is termed a White Trout, and in Wales it is named "sewin."

In regard to the Welsh Sea Trout, it is stated by several naturalists that the sewin differs somewhat in shape and appearance from the Sea Trout of Scotland and Ireland and the "peal" of Devonshire, and a distinguishing scientific appellation, *Salmo Cambricus*, has been given to the sewin of the Conway, Towy, and Dovey.

Sea Trout are visitors to all the uncontaminated rivers of the north-western counties of England, to most of the streams of Wales, in their tidal lengths, and in some cases in their upper waters, and to the rivers of Cornwall and Devon. These migrants also ascend some of the Sussex streams; but they are scarce in the rivers of the East Coast until we reach Yorkshire. In the rivers of Scotland, on the eastern side, Sea Trout are found in considerable numbers, and in such streams as the Findhorn and the Deveron they are very abundant in wet seasons.

Sea Trout are even more restless and passionately impelled by the spirit of wandering than the adventurous salmon. They congregate in large shoals in the estuaries during the summer and autumn, and come into the lowest fresh water pools of the rivers with each tide. If the stream is low through a long period of dry weather, the fish travel no further than the first reach of fresh water, where they remain in expectation of a flood which will enable them to continue their journey in safety.

In the little Aeron, which enters the sea at Aberayron below Aberystwyth, Sea Trout assembled in hundreds below the first weir during the hot drought of the summer of 1908. It is under these conditions that the fish are extremely "shy" of taking an artificial fly or a baited hook, and though they may be seen leaping from the water, and roving impatiently to and fro in the pool, they are seldom captured.

The bulk of Sea Trout exposed for sale are taken in nets at the mouths of the rivers. Their chance of avoiding capture is small in some of the estuaries where numerous nets are continually at work; but on Sundays, when the nets are taken off, they travel up the stream as far as they can proceed without the danger of

HOLTS OF THE SALMON TROUT.

exposing themselves on shallow stretches. Urged by a vehement desire to reach the higher pools of the rivers, Sea Trout will even venture to cross dangerous "stickles," "scours," or shallow lengths,

A SALMON TROUT BREAKING THE SURFACE OF THE WATER.

under the cover of darkness. But the less adventurous travellers lurk in the deep pools and in the heavier water until rain has swelled the river.

The instinct of hiding is exceedingly strong in the Sea Trout. A three or four pound fish will conceal itself with remarkable cunning in a small pool of a mountain burn. An overhanging ledge of rock, a big submerged stone, a hollow in the bank, or the roots of a tree growing from the water, afford "holts" for the Sea Trout. In low water the fish remain in these harbours during the day, only venturing out after sunset to seek for another pool higher up the river

In a tributary of the Towy, during a long drought of 1908, twenty Sea Trout could be counted in a little pool at sundown. The water was so abnormally low and clear that the fish could be watched gliding out of their holts in the banks, and gathering below the waterfall that obstructed their upward journey. One day a thunder-shower discoloured a short length of the stream, and in about an hour an angler caught nine Sea Trout, with a worm on his hook. Yet before the rain fell not a sewin could be seen in this part of the stream. Discoloured water, either from the bogs or the roadways, gives to Sea Trout the intimation of a rise in the water, and at this signal they are urged to continue their travels. Coming out of their lurking-places, they quest up the stream for any channel that will afford a way of progress to fresh haunts.

The migrations of Sea Trout are full of interest. Their courage in attempting to leap up waterfalls is like that of the salmon and the brown trout at the time of spawning. A Sea Trout cannot leap so high as a salmon, but it will endeavour to emulate the jumping feats of its stronger and bigger neighbours in the pool. Again and again, these athletic fish hurl themselves up the rush of white foam, to be beaten back by the powerful force of the waters. The Sea Trout seems to possess a highly frolicsome nature. It delights in jumping and sporting in the pools, especially about the hour of sunset and at daybreak. A Sea Trout of a pound in weight can leap from three to four feet from the water. It will shoot up into the air, like an arrow, turn a somersault, and dive back into the water with a splash.

Another characteristic of the Salmon Trout is its sociability; the gregarious

instinct is strong in the species, and the fish swim in shoals during their migrations to and from salt water. It is this that makes Sea Trout a somewhat easy prey for the net fishermen. The fish that escape the nets are said to travel at the pace of twenty miles a day; and they hurry on until stopped by a high cascade, or by a shallow which they fear to cross.

Assailed by curiosity or hunger, Sea Trout snap at a lure with boldness soon after entering fresh water; but a fish that has been in the river for some months is more cautious in accepting a bait. These "pool-locked" or "pool-bound" fish are by no means easy of capture; they conceal themselves very cunningly, and regard all the angler's enticements with suspicion.

The voracity of Sea Trout under certain conditions is very extraordinary. In a peat-stained water, a hundred Salmon Trout have been taken in one day by a rod fisherman, employing a worm for bait. Yet in brilliant weather and a low state of the river, it is difficult to capture half a dozen of these elusive fish.

As a sport, fishing for Sea Trout is esteemed second to salmon fishing. There are anglers who even prefer a day with Salmon Trout to a day with the salmon, for the smaller migrants often rise boldly to the fly, and when hooked, they fight with a courage and strength excelled by no other fish of their size. The flies used by anglers for Sea Trout are usually gaudy, with tinsel bodies, and it is probable that they are mistaken by the fish for the small fry upon which they feed in the sea.

The chief enemies of the Sea Trout in fresh water are first and foremost the poacher, who often drags the pools by night with his sweep-net; the fisherman, who uses the rod and line fairly; the otter, the heron, and sometimes the cormorant and the gull. Sea-birds of prey are wont to follow the companies of small Sea Trout up the rivers, and to take toll of them. The herring gull will seize a half-pound fish with ease, and when these birds come up with the fish in flocks, there is considerable loss of Sea Trout. The otter catches a Sea Trout here and there, when the water is low, but, as I have said before, otters are less mischievous among fish than anglers suppose. Only once during many years by the riverside have I seen a Sea Trout that an otter has taken from the water. This was on the banks of the Teign, in

EVENING: WHEN SALMON TROUT RISE.

Devonshire, where I picked up a "peal" of about a pound in weight upon which an otter had made a light repast. The animal had only eaten a portion of the back of the fish. No doubt the otters would kill more Sea Trout if they were easily caught. As it is, the eel is the chief prey of the otter.

Salmon Trout frequent lakes communicating with streams, and in many of the Scotch and Irish lochs and loughs, and in some of the Welsh llyns, are abundant during the summer and autumn. In the day-time they appear to haunt the deeper water, but after dark they come into the shallow bays, close to the shores, when they may be heard splashing or seen leaping into the air. The Sea Trout is associated with scenes of wild beauty, such as the gorge of the Findhorn in Scotland, the Falls of the Conway and the Pass of Aberglaslyn in Wales, and the brawling rivers of Cumberland. In the pink glow of sunset, these nimble, silvery fish play in the pools and leap the waterfalls, affording a sight that lives long in the memory of the lover of Nature or the angler. No fish is so joyous as the Sea Trout fresh from the sea, and none so graceful in its leapings and play.

After a sojourn in fresh water the Sea Trout loses its bright appearance, and the silver scales become duller and tinged with brown. A few spots or blotches of a dark colour develop, and the fish becomes reddish, something like the colour of a pool-bound salmon in dry weather. Upon its return to the sea, the silver of the scales soon regains its sheen and rainbow tints.

The growth of Sea Trout in the first year or so of their lives is proportionately as rapid as that of the salmon. Their sea-water diet is highly nutritive, but it is doubtful whether they gain weight in the rivers. After spawning they are listless and attenuated. They lie inert on the gravel shallows, and their armour is dull and slimy. In the sea they attain vigour quickly; the flesh soon becomes firm, the shape improves, and the scales are burnished anew.

WALTER M. GALLICHAN.

A WEIR WHICH SALMON TROUT LEAP.

WINTER.
From the Painting by R. W. Arthur Rouse.

HOW TO KNOW THE REPTILES

By DOUGLAS ENGLISH, B.A., F.R.P.S.
Author of "Wee Tim'rous Beasties," "Beasties Courageous," etc.

THE LIZARDS

THE SLOW WORM. THE SAND LIZARD. THE COMMON LIZARD.

With Photographs by the Author

IT is customary to introduce reptiles with some form of apology, and I imagine that it is with this intention that Dr. Gadow prefaces Part II. of his "Amphibia and Reptiles" with the philosophic reflection of Sancho Panza: "We are all as God made us, and many even worse."

But there are reptiles and reptiles.

There is little doubt that the majority of civilised mankind regard snakes with abhorrence, and that the snake worship of some uncivilised tribes has its origin in fear. In most cases a distinct effort of the will is needed to overcome this feeling, and I must confess that in my own case the will is not equal to the willingness. I have never schooled myself, for example, to keep my face close to the glass of an adder's cage while the adder strikes at it. Reason tells me that no harm can possibly occur, but instinct flings me backward.

Most horses will shy at a snake, most monkeys chatter. It is no doubt from an association of ideas that human beings attack Slow Worms, and though I fear that it will be long before the amiability of this gentle, philosophic lizard is universally recognised, it may be of service to him if I lay some stress on the characteristics which distinguish lizards from snakes, so that, though one Slow Worm may have been thoughtlessly killed, there may be no reasonable excuse for killing a second. There are three unmistakable characters in a Slow Worm's head. To begin with, he has movable eyelids—a thick upper one, and a thin under one; also a nictitating membrane which sweeps backwards on occasion from the anterior corner of his eye.

A snake has no eyelids, his eyes being protected by a fixed transparent scale, which becomes opaque when he is sloughing, and is shed with the rest of his skin.

A MALE SAND LIZARD.

The length of the tail, which in male Lizards is proportionally longer than in females, should be noticed. *See* illustration of the female Sand Lizard on p. 503.

A Slow Worm's under jaws are firmly united in front. A snake's under jaws are loosely united, and widely distensible. A Slow Worm's tongue, which is usually black, though I have known purple, and even pink, variations, is notched at the tip, and flickers momentarily ; a snake's tongue, which I have always found black, is deeply forked, and quivers for a perceptible time.

A further well-marked distinction is to be found in the under surfaces of the two reptiles' bodies. Forward of the tail, which commencement is marked in both by an aperture, the Slow Worm presents four or five parallel rows of scales, while the snake shows a single row of plates.

A COMPLICATED SLOW WORM.

The main cause of confusion between Slow Worm and snake lies no doubt in the fact that the former possesses no external limbs. It is probable that a limbless lizard is a degenerate form. However this may be, the Slow Worm has reduced limbless progression to a fine art, for it must be remembered that in comparison with a snake he is, in a sense, handicapped by his own smoothness.

A Slow Worm is highly polished all over. One might almost suppose that he had received a thick coat of varnish to smooth down the slight asperities of his scaling. If a fingernail be passed along his under surface from tail to head, it will be found to catch at intervals in the hard muscular tail, but to slide smoothly over the soft, yielding body. One may assume from this that in the tail portion the hind ends of the scales form slight transverse ridges. Such ridges would, of course, assist the Slow Worm in movement, and their absence from the body portion is probably balanced by the fact that the latter admits of easy indentation, and so adapts itself naturally to ridges and depressions in the ground.

It is instructive to place several Slow Worms on a large pane of glass, and to observe how every trifling inequality of surface is taken advantage of, so that, eventually, all reach the edge. Two of them meeting will push off against each other, and in this case victory, so far as progress is concerned, goes to the lightest. The object of each Slow Worm is evidently to discover some minute projection or depression against which he may thrust either his head or some portion of his tail. With such a *point d'appui* (it need only be a slight one) he can, by muscular effort, swing from side to side until he finds a second point which presents some mechanical advantage, or a combination of points, which enables him to move in the direction on which he has set his slow-moving but tenacious reptile mind. Given this power on glass, the smooth, delicate and exquisitely balanced motion of the Slow Worm in his natural surroundings need hardly excite surprise. He flows as a peaceful winding stream.

Moreover, he can climb. If a Slow Worm be confined in a rectangular cage he will often be found standing almost straight on end at one of the junctions of the sides. Sometimes he will dispense with the assistance of a corner, and rear a considerable portion of himself against the flat. In both cases the weight of the extension eventually proves too great for the support, and he topples backwards.

I am inclined to think that the main locomotive power of a Slow Worm centres round his tail vertebræ, and that he can only be fairly described as " slow " when, as is very frequently the case, he has lost a large proportion of these useful adjuncts. The perfect tail in the adult is more than half the total length.

" Blind " Worm is, of course, a mis-

1

2

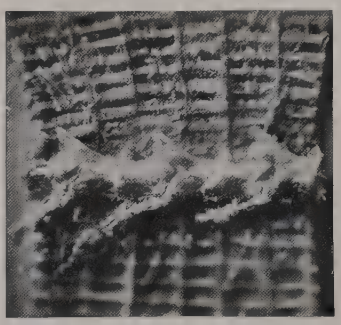
3

THE THREE BRITISH LIZARDS.

1. The Common Lizard (female). 2. The Slow Worm (female). 3. The Sand Lizard (female).

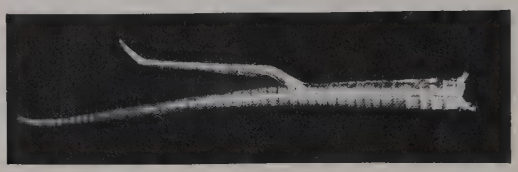
nomer. There is a general tendency amongst the unobservant to regard creatures with small eyes as blind. "Blind as a bat" is proverbial, and "blind mouse" (=shrew mouse) still holds its ground in the north.

From the brittle nature of his tail (a characteristic which is peculiar to lizards) the Slow-Worm gets his distinguishing epithet *fragilis*. For a description of the anatomical structure which makes dislocation of a lizard's tail not only likely at certain definite spots, but inevitable if sufficient violence be employed, I must refer the reader to Dr. (now Professor) Leighton's excellent book on British Lizards, and I must content myself here with a *résumé* of his investigation.



1

2



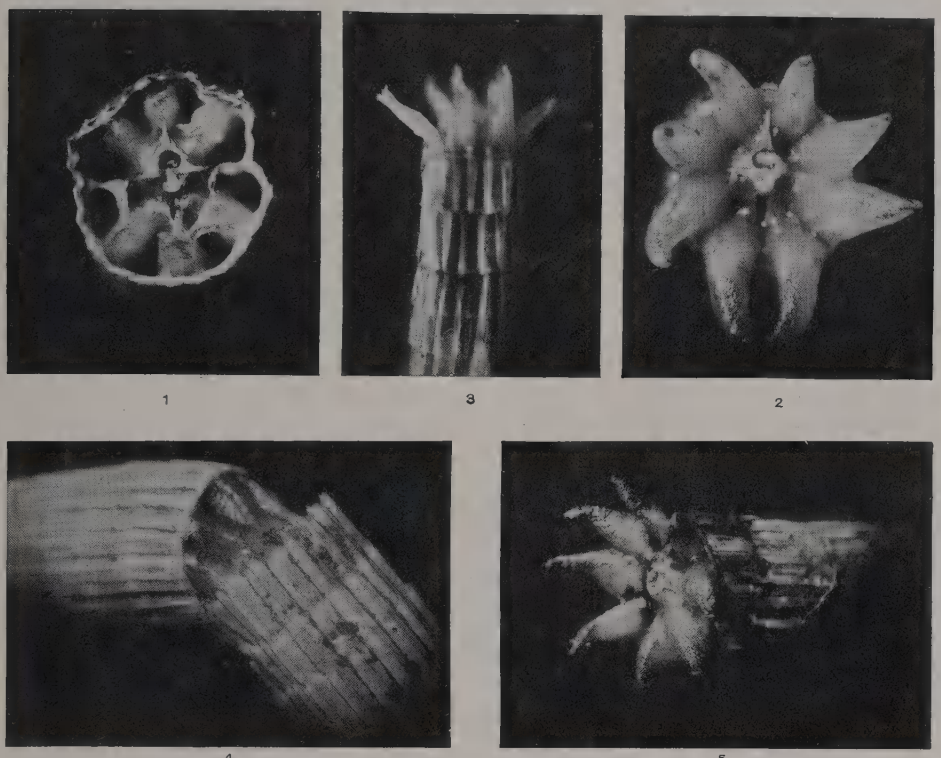
THE NORMAL TAIL DISLOCATION OF A LIZARD.

1. Three vertebræ *in situ* between two dislocations of a Lizard's tail. It should be noted that they are not broken, and that each vertebra corresponds in length to two rows of scales.
2. A single vertebra of a Lizard's tail, showing the weak spot, a partially ossified slit, where it used to be supposed that fracture normally occurred.
3. A portion of a Lizard's tail showing a secondary out-growth (false tail) from a point on the upper surface where there has been some injury.

Before this investigation was published it was generally supposed that the brittleness of a lizard's tail was due to the existence of a weak spot in each of the tail vertebræ. This weak spot takes the form of a transverse split which is incompletely ossified. It occurred to Professor Leighton that the fracture of a weakened vertebra would not necessarily involve such injury to the surrounding integument as would cause the tail to drop short off. Experiment showed that his objection to the view previously held was well founded. A lizard's tail which is subjected to violence does not break across a vertebra, but between two vertebræ. The fracture is confined to the skin, the remainder of the accident being a dislocation. That comparatively slight violence is necessary to produce a *complete* dislocation is due to a peculiar arrangement of the tail muscles. As can be seen from the photographs, the muscles of the centre fragile portion of a lizard's tail are arranged round it lengthways in successive groups of eight—two muscles in each group being towards the upper surface, two on the right, two on the left, and two on the under surface. The proximal ends (those nearest the body) of these muscles fit somewhat weakly into sheaths; the distal ends (those furthest from the body) are firmly attached to the vertebræ and the skin. In a dislocation of the tail the scales are wrenched apart, the skin broken, the muscles whipped out of their sheaths, and the vertebra to which their distal ends are attached parted from the vertebra which immediately precedes it. An end-on view of the portion which a lizard leaves behind him presents, to some extent, the appearance of a sea-anemone, and this appearance is heightened when, as in one of the illustrations, the eight dislocated muscles are spread out. The portion which a lizard retains reveals the distal end of a vertebra surrounded by the cavities into which the muscles of the lost portion fitted. In the Sand Lizard and the Common Lizard the points liable to dislocation can be easily determined from the fact that two scales go to one vertebra. Given, therefore, one dislocation, further dislocations can easily be produced at intervals of two scales from it. To the naturalist who is left with a lizard's tail in his hand (where he would fain have held a lizard), I would recommend as consolation the proof, if further proof be necessary, of Professor Leighton's inter-

esting discovery. He will find that dislocations can be effected with fascinating regularity at every second scale, until he reaches the point where the tail is sufficiently attenuated and sufficiently elastic to be bent beyond itself without breaking.

tion, while a violently excited lizard will stiffen his tail and lash it from side to side. Should there be clear space for this manœuvre, no harm will result, but should the stiffened tail strike some non-yielding obstacle (the wall of a cage, for example)



1 3 2

4 5

THE NORMAL TAIL DISLOCATION OF A LIZARD.

1. The distal end of a Lizard's broken tail, showing the end of a vertebra and the eight hollows surrounding it, into which eight muscles fitted loosely.
2. The proximal end of the same, showing the end of the succeeding vertebra, and the eight muscles spread outwards.

3 and 5. Two other aspects of the proximal end.

4. A partial break, showing the muscles of the proximal end (left) half-freed from the sockets at the distal end (right).

He will find a further fascination in the curiously uncanny movements of the tail as he dislocates it. Such movements last for a considerable time, and can be felt even when they have ceased to be visible.

The dislocation of a lizard's tail is so easily accomplished that it is not surprising to find the belief prevalent that a lizard can part with this portion of himself voluntarily, and that he does so with a view to divert attack from his body.

A wild lizard who is pinned or caught by the tail alone, will make such a wriggle as will almost invariably cause a dislocadislocation is very liable to occur, and in this case a second blow will send the tail-end flying.

It is established that lizards reproduce a serviceable tail-like organ in place of a lost tail. It is also established that a second or even third false tail may branch off from a point on the main trunk line where there has been an injury, but not a sufficient injury to cause complete dislocation. Of one such secondary "false" tail I give an illustration. It contained no vertebræ, but, in place of these, a flexible rod of cartilage. In the

Slow Worm an outgrowth from a tail-stump often shows a reversion to immature colouring, the light tint of the upper surface being sharply divided from the black of the lower.

Individual Slow Worms show remarkable variations of colour, and I am inclined to think that these variations depend more upon age than upon either sex or locality.

At birth the young Slow Worm (he is born in a membranous envelope from which, after absorbing most of the contents of the yolk sac, he frees himself by more or less prolonged struggles) is characterised by the sharp demarcation between the silvery grey of his upper surface and the black, or deep copper brown, of his under surface. The whole of him is highly polished. A dark median line runs the length of his back, and forks where it approaches the head. An irregular dark marking between his eyes is sometimes separated from this line and sometimes produced backwards to meet it. Magnification will show that the median line is zigzag, and that it has its origin in a pigmented line of junction between parallel and dovetailed scales. It never entirely disappears, though in an adult Slow Worm it often presents a herring-bone rather than a zigzag pattern. The silver grey of a young Slow Worm soon changes to a yellow-brown tint, and, as he develops, this tint tends to spread over his sides, and to obliterate the distinction between his upper and his under surface. In adult Slow Worms there is seldom much black to be seen. They may be brown-olive, lead-coloured, copper, or even pink. Melanism may, of course, occur, and albinism also. I have seen several dark specimens with patches of azure on the throat, but, as is the case with blues and greens generally, this colour appears to be structural and fades soon after death.

Little is known of how the Slow Worm passes his time, but everything points to his appreciation of a quiet life, and of the society of his own kind. A Slow Worm may sometimes be found lying wrapt in contemplation in the middle of the high road. It is charity to move him. More often he will be sighted sunning himself before the dew is gone, or crossing the field-path after rain, but the Slow Worm hunter who depends on such fortuitous encounters will have a light bag. The largest catches occur when one happens on a pile of stones or *débris* which conceals a community. Slow Worms are curiously conservative reptiles. Year after year the same stone shelters them—they take four or five years to mature, and we may assume them to be long-lived—day after day they sun themselves (weather permitting) in the same spot and at the same time.

In certain localities one may, on a fine day, find a dozen specimens in as many minutes; one may visit the same spot on a cold day, turn up the same stones, and not find a single one. As anyone who keeps Slow Worms under reasonably natural conditions will soon discover, they are efficient burrowers in soft soil, and in uncertain weather will often lie with their noses just above ground level, and the rest of them concealed. Their burrows are just of sufficient diameter to admit their bodies.

Perhaps a Slow Worm's normal lodging (under a stone) is determined by his normal food. This, as was first pointed out by the late Rev. J. G. Wood, consists of slugs. Professor Leighton writes: "The Slow Worm either gradually approaches, or allows the slug to approach him, until the latter is within reaching distance, then poises his body in a delicate curve over the body of the slug, and with a quick movement—the only sign of haste in the whole business—seizes the mollusc by the middle. . . . The slug never takes the slightest notice of the Slow Worm until it is seized." The latter observation should account for the Slow Worm's natural habitat—"'Will you walk into my parlour?' said the Slow Worm to the Slug."

Of four-legged lizards we possess two species—the Common Lizard (*Lacerta vivipara*), and the Sand Lizard (*Lacerta agilis*). I mention these two scientific names as remarkable examples of inexactitude, even when due allowance is made for the fact that they belong to an inexact terminology. *Lacerta vivipara*, if it means anything, means "the lizard which produces its young *alive*"—a highly creditable quality, no doubt, but hardly a specific distinction. *Zootoca vivipara*

THE HATCHING OF A SLOW WORM.

1. The egg immediately after deposition.
2. The egg smaller, the Slow Worm absorbing the yolk.
3. The Slow Worm now plainly visible inside the membranous egg-covering.
4, 5, 6. Various attitudes adopted by the Slow Worm in its struggles to free itself.
7. The head free.
8. The tail free.
9. The Slow Worm free except for its attachment to the yolk, which it is still absorbing.
10. The final stage.
11. Young Slow Worms about ten days old, showing the characteristic median black line forked near the head.

(an alternative title) contains the same useful information expressed both in Latin and in scientific Greek. Both *vivipara* and *zootoca* are evidently meant to mean "which produces eggs which hatch at birth or immediately after birth." But even if we allow this loose interpretation to the epithets, they cannot be brought into line with fact. The Common Lizard may produce eggs which rupture at or immediately after birth, but often, like the Slow Worm, she produces eggs which do not rupture at birth, and occasionally some hours elapse before the young lizards, which are very dark in colour, escape from their prisons. The Sand Lizard, whose epithet *agilis* is, if we compare her with the Common Lizard, on the *lucus a non lucendo* principle, lays eggs whose covering is fairly substantial, conceals them in the

sand, and leaves them to hatch out by heat. I have no experience of young Sand Lizards. The British Museum catalogue describes them as "greyish brown above, with longitudinal series of white, black-edged ocelli; no light vertebral streak; lower surfaces whitish, immaculate." A half-grown Sand Lizard, which I captured in July, 1908, near Hindhead, was bronze-green all over. Much of his lustre faded before he retired to hibernate, but he was never anything but green, and I look forward to his reappearance in 1909 with some curiosity.

A WALL LIZARD SHOWING FIGHT.

This picture is included in order to show certain distinctive features of Lizards—the "gular fold" beneath the chin, the collar, the enormous gape of the mouth, and the lash of the tail, which sometimes results in dislocation of a portion of it.

The main differences between the Sand Lizard, who is mainly confined to heath land in the South of England, but occurs sporadically near Southport, and the Common Lizard, who, besides being plentiful in Great Britain, has been bold enough to defy St. Patrick by a re-invasion of Ireland, are those of shape and size. I may perhaps leave my photographs to suggest these differences, but I would call the reader's attention to the longitudinal rows of white spots on the Sand Lizard's flanks, which I have never yet encountered in the Common Lizard, and to the fact that the Common Lizard is orange or yellow beneath in the summer, while the male Sand Lizard tends at the same time to have a green wash on his sides, and to be green-yellow beneath, with an abundant spotting of black.

The specific distinctions in scaling are somewhat obscure, but it may be useful to the field naturalist to know that in the Common Lizard there are twenty-six to thirty-seven scales across the middle of the body (excluding the ventral plates), and that in the Sand Lizard there are thirty-four to fifty-two.

If the reader happens to secure in the heath country of Wiltshire, Dorsetshire, Hampshire, West Sussex, or Surrey, or in the neighbourhood of Southport, a stout lizard some eight inches long with well-defined rows of white spots, a somewhat blunt nose, and (superficially) a brown, black, and white, here and there green, coloration, he has probably got a Sand Lizard. Should he, however, secure a slim lizard some six inches long, with a pointed nose, no white spots, an orange or yellow belly, and (superficially) a red-brown and black coloration, with a dark line down the centre of the back, and two dark lateral bands, he has probably got a Common Lizard.

The habits of the two species appear to be very similar. Both have a prolonged hibernation, the Sand Lizard, as one would expect, being the last to emerge, and the first to retire. Both are carnivorous. Both slough their skins. Both are sun lovers, and will flatten their bodies against the ground, so as to present the greatest possible surface to the sunshine.

"For now the noonday quiet holds the hills:
The Grasshopper is silent in the grass;
The Lizard with his shadow on the stone,
Rests like a shadow——"

This is the best time to catch him; with a thin rod and a running noose, even as the Greek youth, immortalised as Apollo Sauroctonos, caught him two thousand years ago.

DOUGLAS ENGLISH.

Photograph by Frith & Co., Reigate.

"IN THE MORNING A MYRIAD OF STAR-LIKE SPARKLES ON TREE AND SHRUB, ON THE GRASS AND BARE FURROWS."

WINTER IN EXCELSIS

By ARTHUR SCAMMELL

IN that most delightful record of an unhappy experience, the "Confessions of an Opium Eater," De Quincey lays down for us "An Analysis of Happiness," and stipulates as an essential part of "the science," that the season "shall not be spring, nor summer, nor autumn, but winter in its sternest shape. I put up a petition annually for as much snow, hail, frost or storm as the skies can possibly afford—I am not particular whether it be snow, or black frost, or wind so strong that you may lean your back against it. I can put up even with rain, provided that it rains cats and dogs, or, as sailors say, 'great guns and marline-spikes,' but something of the sort I must have."

This very precise and forcible statement expresses not only the personal predilections of the writer, but may be taken as a general idealistic view of the weather. The Idealist, with his passion for Nature, has the lover's desire to see the beloved always at the height of beauty and animation; and her mood is at all times reflected in his; the tide of his spirit rises and falls at her bidding.

Cymon, the clownish, finds the sleeping Iphigenia in the wood, and so long as her eyes are closed, his gross nature is untouched, but when she wakes and looks him in the face, that moment a new soul is born within him. And so to those who love the season of winter, the only bad

weather is stagnant weather, when the air is thick with fog, and the meadow turf oozes beneath the foot, when no sound of wind is heard in the trees, and the wayfarer's soul is vexed with the squalor of the mud; when "neither sun nor stars for many days appear"; and

Photograph by J. H. Powell.

"THE REPOSE OF NATURE."

the repose of Nature suggests the lethargy of disease, rather than the calm of healthful sleep.

"And now men see not the bright light that is in the clouds," complains an old writer, doubtless of just such weather; but, he tell us, "the wind passeth and cleanseth them." Let only the mighty current of the south-west begin to flow, and the world is transformed; the flat cloud ceiling is broken up into life and form and colour, torn flying banners upon a field of blue; or if the canopy remain unbroken, still the clouds are defined, and as they sweep across the sky, wave after wave in endless procession, their sombre, ever-changing hues and fantastic outlines seem to suggest a series of world pictures. Pictures of all things that are ancient and grey and remote; pale reflections of scenes over which their flight has carried them; caverns and gorges of bare mountain sides; rocky coasts and forgotten watch towers; stretches of desert sand, strewn with desolation of ruined cities; the restless, ceaseless flow of ocean waves, and the shadow of mighty forests.

The rain forms into steeply slanting columns which hurry across the scene, keeping pace with the clouds, and all the trees strain at their moorings and strive to follow; earth, air and water in flight, a world passing away.

Passing away to the sound of a music worthy to be the dirge of an old world, or the herald of a new. The sound of the wind in the forest—sonorous as thunder or the noise of raging breakers, and yet speaking to the spirit with the clearness of a still small voice: of all the summonings of Nature surely that which brings us nearest to her very presence; a voice which shakes the veil that for ever hides the inner mysteries; that tells us, could we but hear aright, of things "we have not seen nor shall see."

We know the atmosphere to be the instrument as well as the vehicle of sound, but usually the air is the passive agent: sounds made by concussion, vibration and the like, are cast into it as a pebble is thrown into water; but this wood music is of the wind's own making; the forest, a vast mute harp, stretches the ten thousand strings of its branches, waiting for the touch of the minstrel, and then away in the dark south-west the eager wind arises, and like some Orpheus returning to his lyre, sweeps the strings, and fills earth and sky with music.

For the full enjoyment of this phase of winter one needs to be in a land both

"THE FILM OF FROST BECOMES A DEEP CRUST."

Photograph by Frith & Co., Reigate.

hilly, and well but not continuously wooded. Such a country as Holmesdale in Surrey, or West Sussex downland, where groves of ancient beech, worn and twisted by a thousand storms, shout across the valley to the pines that fringe the opposite ledge; deep calling unto deep. There one may traverse long trough-like hollows running counter to the course of the wind, in almost perfect calm, and hear the continuous pealing of the storm on either height, whilst the low dark clouds hurrying overhead seem like visible embodiments of sound.

But the gale blows itself out; the wind goes down with the early-setting sun, and as it drops it would seem as though the cloud procession had, at last, come to an end. At the horizon there appears a long window of purest light, and the effect of this brightness below and gloom above is transfiguring, so that men and beasts, the houses, the trees and the hill slopes, put on a beauty not their own, and look as though they belonged not to this dull, stale earth, but rather to some shining world new made. To such a world as yonder trembling silver sphere, the star of evening, that now adds glory to glory in the western sky.

The night will be serene, and the sky black and set with stars, with frost towards morning; a white frost which begins what may be described as the Halcyon Winter; a period of calm with clear skies and moderate cold; gleaming stars at night, and—as though the earth had learnt something of their art of clear shining—in the morning a myriad of star-like sparkles on tree and shrub, on the grass and the bare furrows: a genial warmth prevails at midday, and buds open out in sheltered places on elder and honeysuckle, whilst the missel thrush sings with all his heart; these summer-like touches are surely Nature's dreamings, stirrings of Mother Earth in her winter sleep.

The combined sharpness and brightness of such a time imparts a wonderful purity to earth and air. The ground never looks so clean as when crisped by the white frost: crisp also, and invigorating beyond its wont, is the breath of the morning.

This for the country; but these conditions of calm and cold often produce fog in the streets. A layer of smoky, artificial fog, with an inefficient sun—orange-hued and rayless—dimly visible above the house-tops; so that a walk into the country in such weather is specially blessed in an atmospheric sense, an exchange of sulphuric acid for ozone.

Away at the extremity of a south-west suburb the tide of houses is stayed by a noble expanse of common land; open heath at first, but farther on a broken hilly region, wooded, and intersected with brooks. In the midst is a steep knoll grown over with silver birches, and on a winter morning of sunshine and light frost, the beauty of these trees is almost beyond the possibility of exaggeration; and the sight of them to eyes and mind oppressed by the squalor of foggy streets, may be compared in effect to a melody of Mozart played in a workhouse. Their silvery whiteness is brightened to a crystal shining by the hoar frost; growing one behind and above the other on the steep slope, each tree is suffused in sunshine, and fronts the morning a perfect example of sylvan purity and grace. Standing amongst the trees, and looking upwards, the blue sky gains a deeper intensity from the contrast with the brown hanging tresses, and calm though the air may be—watch—and at a breath, there will be a gentlest swaying of slender stems, a bowing of the cloud-like tops, and a whisper of ecstasy passing from end to end of the grove.

But January brings a tightening of winter's hold upon the earth: the film of frost becomes a deep crust; the sky is again possessed by an army of clouds, no longer borne by the mild Atlantic breeze, children of the warm Gulf stream, but frozen vapours of the North, leaden-winged messengers from Lapland or Siberia.

Midsummer to midwinter! It is not possible for us to realise the world of difference that exists between the two conditions, for no effort of memory or exercise of imagination can bring the two pictures side by side. An old fable tells of a wizard who showed to a Northern king, from the four windows of a room, the four seasons in their prime; but until that wizard returns we cannot know, in the poverty of winter, what a wealth of

life and beauty the summer day can show. The beauty of the world, indeed, is everlasting, and the succession of the seasons only changes the type; but what of life and motion? Molecular changes, no doubt, are taking place within the bodies of plants—a maturing of the coming buds, hardening of woody fibre, and so on—but for aught we can see, the trees, the shrubs, loudly rustling the dry leaves, foraging at night in the coppices; the hare that runs from us neither so fast nor so far as is his wont; squirrels and hedgehogs lying torpid in their hiding-places: such a feeble folk they seem, asking for so little, and so likely to have that little denied them.

The owl is abroad almost before the

Photograph by Frith & Co., Reigate.

"THE WOODS TAKE ON A NEW, STRANGE WILDNESS."

grass and the flowers, all the sweet delights of the year, are dead, and the once teeming earth on its way back to a state of chaos:

"Black, wintry, dead, unmeasured; without herb,
Insect or beast, or shape or sound of life."

Those who study human nature, either in books or amongst their fellow-men, are more attracted by the lives of the poor than of the rich, and so in this time of their poverty the wild beasts and birds have a special and pathetic interest. Tamer, and with less of the lust of living, they are indeed "poor brothers" to us to-day, as to St. Francis of old. The broken coveys of partridges, the flocks of fieldfares taking shelter here from still harsher conditions elsewhere, the silent birds of song feeding far away from home on the hawthorns of the downs; the rabbits sun has gone down, and his call—sudden and loud here in the lane, or faintly echoing from the distant parts of the wood—has, to-night, something of the old unearthly quality, the boding note that made our forefathers tremble; the low, stealthy flight of the home-going rooks seems like those fateful bird-flights whereby the ancients divined things that were to be; and the voice of the wind as it sweeps over the long dark swells and hollows of the downs takes up the same prophetic tale, so that the night seems to be charged with more than night's common portion of darkness and peril and mystery.

The mystery of the snow! For the snow is the last, most vivid expression of winter; not winter's self, but "The very garment that thou know'st him by"; and, therefore—for all the trouble that it brings—the most prosaic amongst us are

moved to a sense of pleasure at the sight. To see the empty colourless air possessed by myriads of dancing fairy flakes, the well-known vistas of street or field cut off by a shifting living curtain; and the woods taking on a new, strange wildness; their shaded hollows becoming

"NEW FALLEN SNOW."

caves of mystery, the hiding-places of dreams.

Who can tell of the beauty of the new fallen snow? The thousand colours of the world overcome with a whiteness the nearest to the absolute which we can know; the feathery stuff—lightness and purity made palpable—laid so daintily by the wind in the hollow lanes and under hedges, in a thousand shapes of ideal beauty and fantasy; and the rosy flush in which the sunset bathes the hilltops.

Yet the snow is not all beauty. The religions of old time armed Jupiter the All-powerful with the lightning—a weapon impalpable, invisible, yet deadly in its stroke beyond anything else in heaven or earth. And when the North-East Wind takes into his hand the snowstorm, what can stand against his power? With this he levels the great trees, paralyses the most powerful of human activities, and takes his toll of human lives. Even the mountains in their pride are at last brought to nothing by those resistless forces of the snow—the avalanche, the glacier and the torrent.

The softer airs of our country bring the season about us in a gentler manner, and the pleasures of fancy are not often broken by wintry violence and disaster, though ardent spirits may have to complain of the opposite faults of dulness and torpor to which it is prone.

Winter has been of late years a long-drawn season; "lingering like an unloved guest." On Easter Day of 1908 Winter was still in possession, though his power was waning; the north wind whistled, and snow-clouds were flying overhead, but between the scuds the sun shone out, and flowers were blooming in sheltered places.

On one side of the lane stretched the beech wood, and the storm swept down the bare avenues and coated the north side of every tree with wet, clinging snow; but on the other side, facing the south, the sun shone warm on the short turf of the hill slope, changing the melting hailstones and snowflakes to gems of brightest colour—pure white of the diamond, burning orange and ruby, amethyst, blue, and sapphire.

At the end of the lane a country girl was standing; on her shoulders the snow lay thick, it filled the folds of her dress, and mingled with her bonny brown hair; but her face, as she stood and listened to the lark, was bathed in sunshine, and her hands were full of wood anemones and primroses.

"If winter comes, can spring be far behind?"

ARTHUR SCAMMELL.

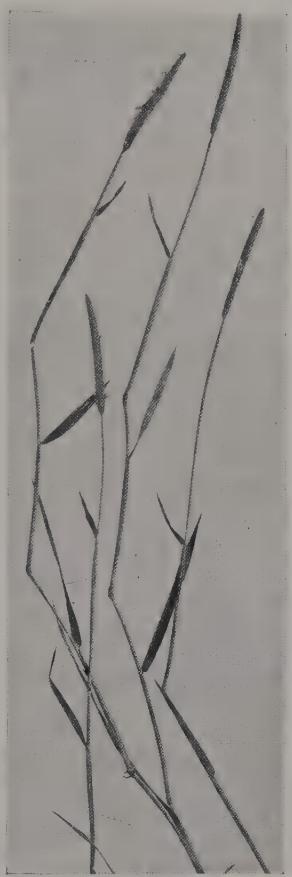
GRASSES OF THE MOIST PLACES

By MAUD U. CLARKE

With Photographs by HENRY IRVING

DIRECTLY we turn from dry land to that more or less associated with water, we then see very striking differences in plant life. The big fact of adaptation to circumstance at once looks us in the face. Of the six illustrations here given, I place two to the front equally as of special interest in showing the moisture-loving grasses ready to adapt themselves to emergency or circumstance: 1. The Floating Foxtail (*Alopecurus geniculatus*); 2. Flote Grass (*Glyceria fluitans*). They live submerged in water in the base growth, with the upper floating and flowering on the surface; yet should the water subside, they can maintain existence on comparatively dry land. This determination to persist under distinctly variable circumstances seems the highest point attainable by what we may term plant-instinct.

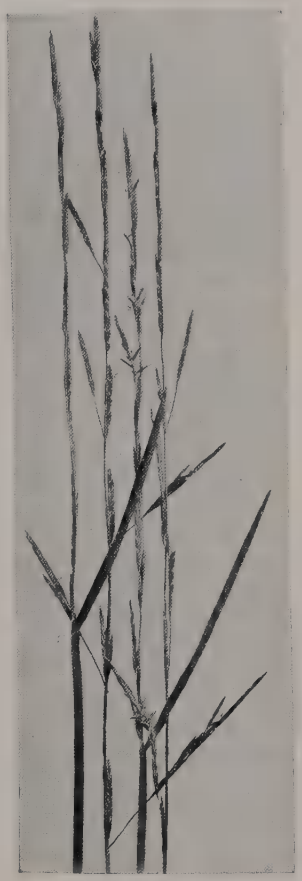
The Floating Foxtail is a much slighter plant than the meadow variety, with long, slender, jointed stems, sometimes lying on the water at the margins of ponds and small pools, or trailing over the moist edges, sending fine fibrous roots down into the mud. In either situation, the flower stem rises at an abrupt angle upwards from one of the joints. The sheath is slightly swollen, projecting a broader blade than those growing at the root, which are finely linear.



FLOATING FOXTAIL.

There is a fragile look about this grass, the colouring of the anthers—a delicate lilac to cinnamon—contrasting with the pale green glumes. It is quite commonly found in the moist quarters flowering from April to August. In the latter month the plant has to be prepared for distinct alterations in ground that was wet enough in spring. I came upon it in the hollows of a common at the latter end of August associated with the rushes where the water had entirely deserted the surface of the ground, and the plants were depending on the supply of moisture gathered in from the densely spreading rootstock below.

An immediate neighbour was the FloteGrass(*Glyceria fluitans*), also semi-aquatic. Now this species shows a distinct merging of character in the direction of the Sedges, for it holds the leaf sheath unsplit. The tall stem can rise three feet when forcing its way up through the rushes surrounding it, but it is rather pliant than stiff. The blade often shows folded flatly together after allowing the escape of the flowering stem. One very distinct characteristic is the manner in which the sections of the flower-spike incline to sharp angles as the flowering stage progresses. This right-angled expression of the plant shows both in the extended branchlets bearing the flower-glumes,



FLOTE GRASS.

and also in the expanded glumes themselves. A gathered spike will eventually assume a singularly ragged appearance; all these sections depart from the vertical character to that of most variable angles, all starting away from each other. The branchlets recurve upon themselves, or make a sharp up-turn from the main direction of growth; the glumes start out sharply, and instead of the smooth, neat look of the spike originally expressed, one might say its "coat stares," the metamorphose is so complete. The illustration shows something of this in the lowest branchlet of the right-hand specimen, and also in the two upper ones of the second; the third specimen shows the branchlets starting out at alternate sharp angles from the main stem.

Most river-banks and smaller streams have the Tall Fescue (*Festuca elatior*) fringing the edges in company with the reeds, rushes, and water-loving plants such as the Great Willow Herb, Purple Loosestrife, and the like. It is a grass that adds well to the jungle of the river-bank, for it is often the imposing height of six feet, with a flower panicle of ten inches. There is a harsh character given to the panicle by reason of the glumes being ribbed and sharply pointed, a characteristic which is accentuated when in the dry state. The blades are flat, smooth, and ribbon-like in appearance. Sometimes the elaborate panicle is represented by a more simple spike, which hangs its branchlets all to one side. Whether the plant determines the one-sidedness, or if it be accidental, is difficult to ascertain; for the prevalence of a certain wind in one stage of the development of the flower-head may affect the formation. One has to make a great number of observations before final conclusions can be sifted from them. It is impossible to go many

THE TALL FESCUE.

yards along a river-bank before one's list of observations is considerably added to, which is fair testimony to the amount of interest the locality possesses.

The Tall Fescue is quite at home also in damp pastures where a stream may

border them ; but here the quality of the hay would be very coarse with such an addition, and practically only fit for bedding cattle.

Marsh land inevitably recalls the memory of the Common Reed (*Phragmites communis*). It stands apart as the only species we have of its kind, and the great stems of eight or ten feet high almost cause us to forget that the plant is a grass. The growth is not only tall but stout, with inch-broad leaves, which, when caught in the wind, flash up the grey under-colouring very beautifully. The rustle and hiss of a mass of Reeds in the wind has a fascination of its own in the quiet of the marshes. Yet this grass is not confined to big areas solely, for it grows beside many a stream, and even a broad ditch will do if it has a fair water-current. Sometimes patches of it stand out in the meadows where the stream has flushed the surface earth. The great panicle of flower—as much as eighteen inches in length—of dark purple-brown is eminently graceful as it sways among the silvery green foliage, and the whole strength of the plant excites admiration as distinctly handsome. It grows all over the world with varying modifications, and is of utilitarian value, since the tough strength of the leaves makes it useful for thatching.

THE COMMON REED.

TUFTED HAIR GRASS.

The purple flowering glory comes in July and August, and yet later, when the plant world is slowly passing into its time of limitation, in the dried stage, the tawny plumes standing in autumn mist are still beautiful.

It is quite likely that the Tufted Hair

Grass (*Deschampsia cæspitosa*) may be found growing in the vicinity of the Common Reed, for it is another water-loving species, and when found in the meadow grass it means that under-drainage is wanted, that water is lying in the subsoil. The Hair Grass is striking in appearance, with the long delicate panicle rising from four-foot stems with its hair-like branchlets carried rather vertically. The individual flower-spikelets are not expanded much, but rather contracted upon themselves, showing a silvery or purple colour in the glumes. In this case the silvery appearance is not caused by the growth of soft down on the plant, for both leaves and panicle are harsh to the touch; the former, broad and flat in form, having the surface roughened with grooves. In the illustration we see the sheath rolled very closely on the stem right up to the point where a secondary leaf-sheath passes through, and one almost looks in vain for the split that always separates the Grass family from the Sedges. For here, in the water-loving grass, we find the merging of instincts, or point of alliance between otherwise separated plants, owing to the necessities of the situation. The sheaths, being the protective sections of the plant's economy, so long as there is need to keep the flower-head from moisture in its immature state, remains firmly watertight where the surround of water enforces such response. One might suppose that water plants learnt by experience—or by so doing survived consequences—that water may rise abruptly and uncertainly, swamp the uprising flowering-stems or tender stage of its advance, and the grass that held the sheath closed succeeded in maintaining its existence best.

REED GRASS.

On the other hand, the grasses of the drier regions habitually split their sheaths on discovery that no such catastrophe occurred as the submerging of the precious flower-head in water. I use the term "discovery," of course, in a qualified sense. Yet it is not altogether inappropriate, since the power of adaptation to circumstance is inherently a factor originating in a sense of discovery or recognition of locality.

In the Reed Grass (*Phalaris arundinacea*) there is so strong a characteristic resemblance in the arrangement of the leaves to that of the Common Reed that no one can fail to recognise the species. The glint of the grey-green stems and broad leaves branching from them in close proximity to each other is unmistakable. In the dry autumn state, the panicle shrinks closer together, and has more the look of a spike, but the branchlets can easily be pressed out into the appearance of the illustration. The large ligules, or extensions of the transparent white membrane which lines the leaf-sheath, are very clearly shown in the two central stems, and they are one of the characteristics of this grass. It is a species that can attain six feet of growth in our moist land regions. Whilst at home in sand, or as a marsh plant, it can equally maintain itself among the crevices of the stone work which line the Thames at Richmond. The whitish green of the flower-head of July and August fades later into a pale fawn-coloured spike, soft to the touch and measuring six to eight inches in length.

MAUD U. CLARKE.

STONE-TURNING—I

By R. A. STAIG

Illustrated from Original Photographs by JOHN A. BALLANTYNE

MANY curious creatures live under stones. Raising a stone here and there we are sure to find some centipedes—a dim-sighted tribe seeking the darkness, little known and not loved.

The rapidity of their serpentine movements is quite bewildering. How they do it, the order in which they move their numerous legs, that is the most puzzling thing about the centipedes. With astonishing ease they run backwards tail foremost. Watching one do this, we see only the hindmost limbs actively used.

One of the commonest kinds is the brown Lithobius, or Thirty-legs, an excellent example of the sense of touch developed to an uncommon degree. It finds its way, seeks its food, and recognises friend and foe, by means of the two long thread-like sensory feelers which project from the front of the head. Eyes it has, more than one pair, but poorly developed, very small, and difficult to see —superfluous possessions to a darkness-loving Lithobius so keenly touch-sensitive.

A well-known zoologist, who found centipede life a more interesting study than many people might readily suppose, tells a charming story of Mother Lithobius and her maternal care. The voracity of her mate and his undiscriminating palate are sources of great anxiety to her when about to bring forth her egg. When it falls out she clasps it firmly between two little hooks at the end of her body, runs off with it, wets it, and rolls it round and round until it is covered with earth. The deception is then complete, and the baby safe from paternal cannibalism.

The dark brown, inch-long, worm-like creature which curls itself up when disturbed beneath a stone is the Julus, one of

LITHOBIUS—THE THIRTY-LEGS.
(Magnified three diameters.)

the millipedes; the vegetarian relative of the Lithobius. Its legs, small and delicate, are so numerous and set so close together as to form a sort of motile fringe underneath the cylindrical body. The movement is peculiar, resembling a slow and graceful wave; the legs, employed in little bunches alternately, performing an undulating motion passing from head to tail.

Before laying her eggs the female Julus makes a little nest. She works up particles of earth with her saliva, gluing them together and shaping them with her feet until she has formed a hollow earthen sphere about the size of a large pea; the wall inside carefully smoothed, outside left rough, not to be distinguished from the surrounding earth. There is a hole in the wall. She drops the minute eggs through the hole, then plugs it up and goes away.

Multipedes are in many ways closely related to insects, and their ancestry is a subject of much speculation.

Common "slaters," the Pill-bug or Armadillo louse, earwigs, the "Devil's Coach-horse," oval-bodied, bluish-black and brownish ground beetles, the vagrant spider carrying her bag of eggs, divers slugs, tiny land snails with exquisite transparent shells—these are all familiar objects under stones upon the ground.

MILLIPEDES (JULUS). PILL-BUG (ARMADILLO) ROLLING UP. (Natural size.) LAND SNAIL SHELLS.

Like the "slaters," slugs, and snails, the Pill-bug loves a damp situation. When danger threatens the "slater" remains motionless, feigning death, but the Pill-bug instantly rolls itself up, the hard, horny plates of its back forming the surface of the "pill."

There is a general resemblance between these two "passive resisters." Both are crustaceans, but, unlike the majority of the crab and shrimp community, they have adopted terrestrial life.

Looking at an Earwig, nobody would imagine it to be possessed of wings; but if we will overcome a little prejudice and examine one of these insects carefully, we shall discover, underneath two small leathery shields upon its back, the organs of flight, each one folded up crosswise and lengthways into a compact little parcel.

These wings, when unfolded and spread out—no easy matter—are exceedingly delicate and beautifully veined membranes, and in shape singularly suggestive of the human ears. It is odd that such exquisite and intricately folded wings should belong to an insect which so seldom uses them. Another Earwig enigma is the possible use of the formidable-looking forceps at the end of the body. These nip very well, and are probably defensive. The forceps of the males are calliper-like, more curved than those which belong to the females, which remind one of flat-nosed pliers.

The "Devil's Coach-horse" assumes a most menacing attitude when come upon suddenly under a stone, cocking up his long, dusky, black body, and exhibiting his powerful mandibles. Usually more than an inch in length, and in general build somewhat like an Earwig without the pincers, this insect is one of the largest members of the "rove beetle" family. Some of the smaller "rove beetles" lead very strange lives. One species dwells unmolested in the nest of the sand-martin; two others—Atemeles and the Lomechusa—are the guests of those social wonders, the Ants.

THREE GROUND BEETLES AND A "DEVIL'S COACH-HORSE." (Natural size.)

Under the flat fragments of rock scattered about on sun-exposed slopes, on hillsides, and in the vicinity of woods,

ANT PUPÆ (SLIGHTLY ENLARGED).

"NURSE" ANTS REMOVING PUPÆ.

we are sure to discover colonies of Ants. If the day is sunny a mass of small cream-coloured objects will be disclosed to view when the warm stone is lifted away. What amazing commotion! What a noise, if our hearing were only keen enough to detect the sounds! Dozens of excited little Ants running hard to and fro among the cream-coloured objects, each seizing one and swiftly carrying it off, or dragging and tugging it backwards; scurrying through the holes into the underground passages of the formicary, to dump down their burdens in safety in the nursery chambers, and then to hurry back again.

FOUR WORKER ANTS AND A WINGED MALE; TWO NAKED PUPÆ, A COCOON, AND A LARVA
(Natural size.)

These bustling little bodies are the nurses, Ants destined never to become queens, workers who begin their useful lives by tending the sleeping babies, as children do dolls, until such time as strength and maturity bring duties more onerous. And while we watch them, within a few moments not a single cream-coloured object remains. Picking up some we notice three distinct kinds: one like a conical maggot, which in truth it is, a little larva newly hatched from the egg. Another is exactly an Ant, so neatly folded up: that is a pupa, and these are most numerous. And the third, not an egg, but a silken cocoon, with a pupa or baby Ant inside. Larvæ, pupæ within cocoons, and pupæ without them; these are our so-called "ant-eggs"—very good for goldfish and pheasants.

The industry of the workers is remarkable. They work all day and occasionally all night; only stopping at intervals to adjust their toilet or to touch each other with their tiny feelers—a few words of friendly communication, no doubt.

The winged forms, which we sometimes see among the workers, are either males or females, or both. After a brief nuptial flight the males soon die; and he females, having removed their own wings, settle down to domesticity in darkness.

Pliny said of the ant, "*in formica non modo sensus, sed etiam mens, ratio, memoria*," and observation demonstrates the truth of this. Ants certainly seem to have special faculties for doing the most extraordinary things. They construct subterranean galleries, they make roads, and they raid for slaves. They use certain Aphides (Green Fly) as "cows," building shelters for them. They keep pets and "paying guests," and even tolerate such parasitic lodgers as the uninvited "slater," who originally rolled in and declined to crawl out. In all Natural History there is no more fascinating study than the ways and doings of the industrious and self-sacrificing Ant.

R. A. STAIG.

Sycamore.
Field Maple.

Norway Maple.
Ash-leaved Maple, or Box Elder.

LEAVES OF THE MAPLES.

HOW TO KNOW THE TREES GROWING IN BRITAIN

With Notes, descriptive and photographic, for their Identification in all Seasons of the Year

By HENRY IRVING

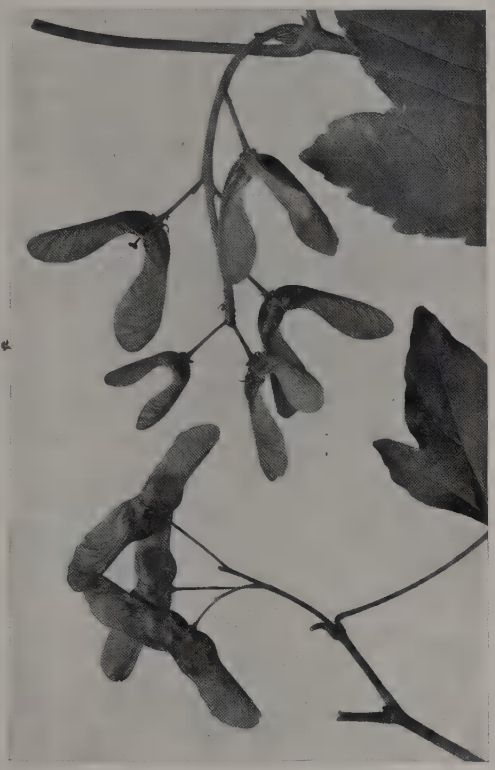
THE MAPLES

IN this group there are two trees of most frequent occurrence—the Great Maple, usually spoken of as the Sycamore, and the Field or Common Maple. Other two, less frequent, are the Norway Maple, and the Ash-leaved Maple, or Box Elder.

These trees, being of the same order, naturally have much in common, but they also show considerable and interesting divergences. The *bark* of the Maples is, as a rule, scaly, that of the Sycamore is the smoothest of the four, whilst that of the Box Elder is most roughened. That of the Norway Maple, however, is not scaly. It presents a surface, broken up into narrow vertical fissures, having some resemblance to that of the Ash in texture, but with a slightly ruddy colouring. One invariable characteristic of the Maples is that the *buds*, and therefore the leaves and the twigs, are arranged in

opposite pairs, each next succeeding pair being at right angles to that preceding. This will be found conclusive in distinguishing, at any season, a Maple from a Plane, on which the arrangement of the buds is alternate. The typical Maple *leaves* are five-fingered, after the manner of those of the Plane; they have five main divisions, each possessing a separate main rib, proceeding from the point of junction with the stalk, and terminating at the apex of its own leaf division. The leaf of the Box Elder is not simple, but compound, after the manner of the Ash or the Elder, hence this tree's alternative names. This compound leaf has usually five (sometimes three only) individual leaflets. The *flowers* of the Maples have special interest for us in that they afford a striking illustration of the different stages intervening between the wind-pollinated flowers without petals or nectar, and the insect-pollinated flowers with nectar and rendered more conspicuous by petals. The Box Elder is entirely wind-pollinated, and has neither petals nor nectar. Moreover, its flowers are distinct, the pollen-bearing from the fruit-producing, and grow on separate trees. The Sycamore's flowers of both kinds grow together in a single drooping cluster, and each flower has small green petals and store of nectar. The Field Maple has similar flowers, but these are grouped in erect, more open clusters, with petals relatively somewhat larger, and yellowish green in colour. The Norway Maple has larger, erect and closer clusters, with larger yellow petals—much more conspicuous, and rendered more so still from the fact that the flowers open before the leaves expand. The *fruits* grow in pairs, as winged seeds, joined at the base. In their dispersal these winged seeds come apart, each as it is borne away by the wind spinning vigorously. They are, in fact, something between a parachute and an aeroplane, and are capable of travelling a considerable distance with the wind. The angle or otherwise which these paired and winged fruits take in

SYCAMORE IN WINTER.



WINGED FRUITS OF SYCAMORE AND FIELD MAPLE.

relation the one to the other, whilst on the tree, is a useful distinguishing mark among the Maples.

THE GREAT MAPLE, OR SYCAMORE

This tree gives the impression of sturdy self-reliance. Though not a native, it has made itself thoroughly at home with us, and its seedlings spring up everywhere, with the abundance and vigour of weeds.

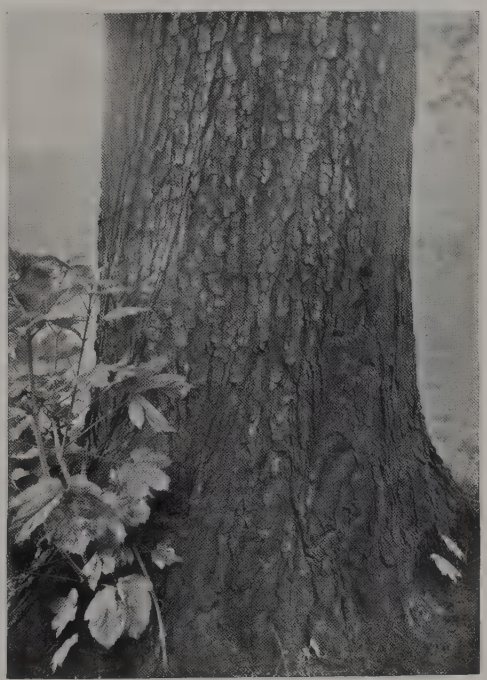
In *winter* it is seen to be supported by a well proportioned main stem from which strong branches emerge, low down, and more or less horizontally, whilst those higher sweep upwards, with set purpose, and terminate in stout forked twigs. It is manifestly built for endurance, and can offer a stubborn resistance in the most exposed situations.

In *spring*, as the young leaves emerge, they show considerable admixture of colour, browns and reds frequently predominating. Expanding, after the manner of a fan, they are large and well sustained. Beneath them, as in a series of delightful tented shades, droop their many-flowered clusters, centres of joyous activity on the part of a multitude of welcomed insect guests.

In *summer* the tree's moulded outline, almost formal in its distinctness, at once differentiates it amongst its fellows. Its billowy masses and rounded bosses of dark and handsome foliage, most skilfully arranged in closest fitting mosaic, intercept and bar every ray of light, and make for all beneath a solid shade.

In *autumn* its graceful lengthy tassels of winged fruits droop, brilliant in reds and browns, amongst the changing leaves as these fade to yellow and brown. But at this season the tree often suffers strange disfigurement, splashed as it were with tar, the black stains of a fungoid growth blot the leaves, making for them a loathsome ending.

The twigs are thick, brown or grey in colour, and polished. The resting buds project at a small angle, and are protected by yellowish green scales. The terminal bud is large. The leaf-scars are



BOLE AND BARK OF SYCAMORE.

1 2

surely one of the most beautiful in nature.

THE FIELD MAPLE

This, when met with as a tree, is of smaller dimensions every way. Except when drawn upwards, seeking the light, through overshadowing of neighbouring growths, it shows a rounded, rather stunted, crown. Chiefly found as a hedge plant, it is most noticeable for its autumn colouring of shining gold, brilliant, as crescentic. The angular incisions separating the leaf-divisions are acute. The leaf-margins are irregularly toothed. The leaf-stalks are often a brilliant red. The paired winged-fruits take the form more or less of a horse-shoe; whilst each separate wing, curving broadly at the apex, narrows towards the base, and is bounded by a flowing line which is

3 4

WINTER TWIGS OF
(1) Norway Maple.
(2) Ash-leaved Maple.
(3) Field Maple.
(4) Sycamore.

with glow of sunshine, amidst the prevailing greens and reds and browns.

The twigs are velvety, yellowish green to brown in colour. These become very thick and corky, after the manner of some Elm twigs, but they do not show the extended elongated wings of the latter. The buds are pressed up against the twig,

CORKY TWIG OF FIELD MAPLE.

and are green to brown in colour. The terminal bud is small. The scars are V-shaped. The leaves have five broad, bluntly pointed divisions; and the incisions between these are deep and rounded. The margins are wavy rather than toothed. The wings of the paired fruits have their edges parallel, and are extended in a straight line, sometimes even reflexed. Crowded excrescences of a brilliant red, the work of a mite, are frequent on the leaves.

THE NORWAY MAPLE

The closest resemblance between a Maple and a Plane is shown by this tree,

FIELD MAPLE IN WINTER.

FIELD MAPLE IN SUMMER.

insomuch that it is described as the "Plane-like" Maple. On the other hand, one of our Planes is distinguished as "Maple-leaved." The Norway Maple may, however, readily be recognised by its bud and twig arrangement, as previously noted; by its bark, which is not

BOLE AND BARK OF NORWAY MAPLE.

scaly but fissured and furrowed; and by the fact that its growing buds, though carefully shielded, are not enclosed in the bases of the leaf-stalks, nor its resting buds surrounded by circular leaf-scars. Here the leaf-scar is V-shaped, with the long arms half embracing the twig and meeting the corresponding arms of the opposite scar.

The twigs are red, or brown, and sometimes green. The buds are pressed up against the twig, shining, and green merging into brown or red. The terminal bud is large. The leaves have five (or seven) elongated sharply pointed divisions; and the incisions between are wide. Their margins also have numerous long and sharp points. Their colour is light green above and below. They have generally five main ribs, with a small additional pair at the base. Before the leaves expand crowds of flower-clusters, at the tips of the twigs, of a greenish golden yellow, make the tree a great bouquet of blossom, one of the most noticeable and beautiful objects of the season. The wings of the twin fruits, having their edges parallel, widely diverge.

RESTING BUD (ENLARGED) OF THE SYCAMORE.

THE ASH-LEAVED MAPLE, OR BOX-ELDER

This tree is usually grown in gardens, preference being given to the variegated form, with leaves both white and green. The twigs are smooth and green, and continue so for a long time, since the epidermis, or true skin, grows with the twig's growth, and does not, for several seasons, split or shrivel, or die into bark. The buds also are green, but coated with silvery hairs. The leaf-scars are similar to those of the Norway Maple. The leaves are compound. The flowers are grouped into feathery tufts, growing with the leaves from the sides of the twigs, and, as already mentioned, are found on separate trees, and are without petals. The twin fruits are joined together at an acute angle, their wing extensions curving inwards.

RESTING BUD (ENLARGED) OF THE NORWAY MAPLE.

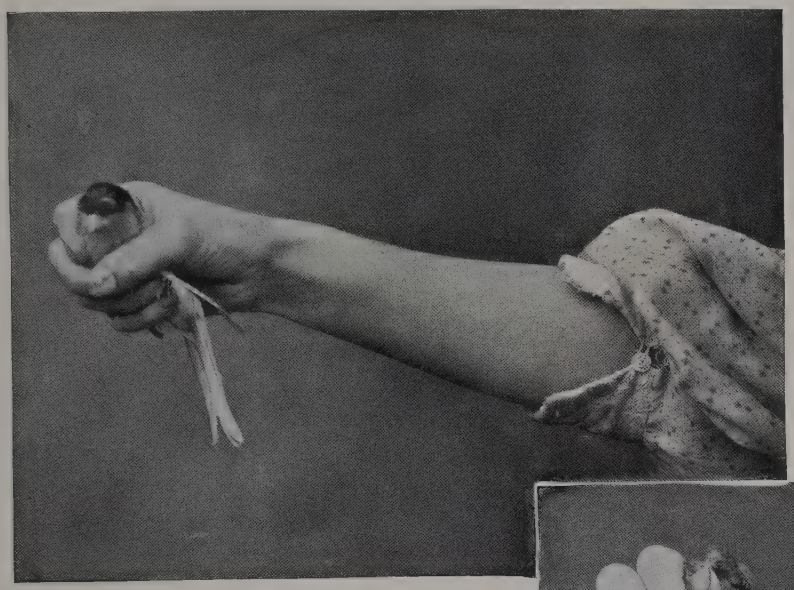
HENRY IRVING.

HOW ANIMALS SHOULD BE HANDLED

By J. H. POWELL

With Photographs by the Author

IT is remarkable that although animals are so largely kept, either as pets or as a means of profit to their owners, few people really know how they should properly be handled. Doubtless in many cases the idea exists that it does not matter how an animal is picked up, and this is particularly so when live-stock is kept simply for profit. The feelings of the animals are not studied, and hence injury is often—though unwittingly—inflicted.

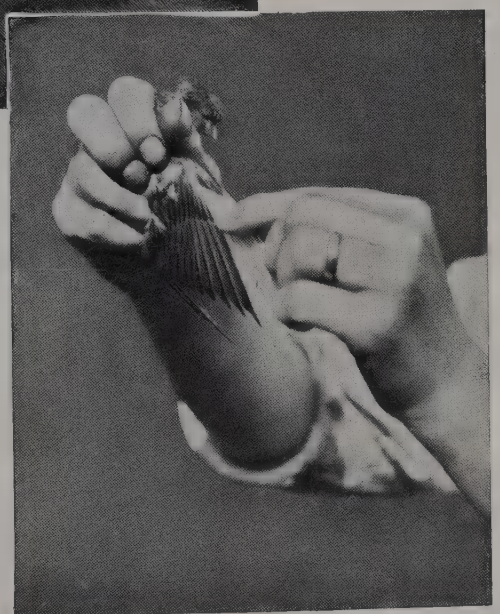


CANARY.

The proper treatment of animals when kept, as they so often are, as pets by young people, should form part of the education of children. How often a puppy or a kitten is to be seen roughly handled owing to the lack of this knowledge on the part of the young owner. With such knowledge much unintentional cruelty would be avoided, and a greater love for dumb creatures would be the natural outcome.

A canary should not be grasped like a puppy, nor a nervous little mouse like a vigorous young kitten. In the case of birds designed for show purposes the plumage can easily be disarranged by injudicious handling, and the prize-winning chances seriously jeopardised.

The canary is undoubtedly one



HOW TO EXAMINE A CANARY FOR WING INJURY.

RABBIT.

of the most popular of pets, and as it is such a fragile member of the feathered tribe it should receive very gentle treatment. It is very easily frightened, and in removing it from its cage the hand should be placed swiftly over its body, so as to keep the wings down and leave the head perfectly free. Great care must be taken to grasp the bird quite lightly and no undue pressure exerted, or internal injury will be the result. The illustrations on page 529, show distinctly how the bird should be held for removal, and also when it is necessary to examine the wing for any trouble.

Too little attention is bestowed upon the handling of an ordinary fowl. Familiarity so often breeds contempt, and provided the bird is caught—by the leg, or the wing, whichever is handiest—other considerations are ignored. Of course, much depends upon the temper of the bird, and if it be vicious the result is even rougher handling than would otherwise be the case. The illustration on this page shows the correct method to handle a fowl. The bird's wings should be firmly grasped just where they join the back. No harm is done to it, and much unnecessary struggling is prevented.

Puppies and kittens are delightful little creatures, and immensely popular as pets, but, as I have already remarked, they are too often dragged about in a manner which must cause the little animals needless pain. It is quite an easy matter to teach children how they should be handled. The popular idea is that very young puppies and kittens should be held by the scruff of the neck, but this is not correct. The shape of a puppy —a most important point in the case of a show animal — is often spoiled by such handling, and injury to its internal anatomy may result. The illustration on this page shows exactly how a kitten — or a puppy—should be

KITTEN

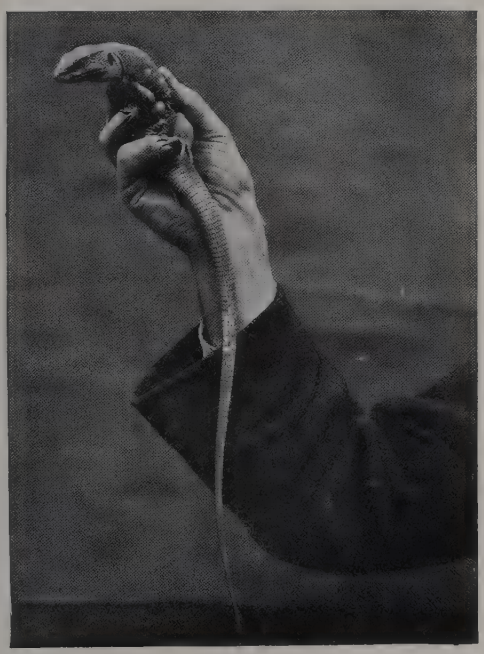
FOWL.

held with the greatest comfort to itself. The hand should be placed underneath the fore part of the body, for by this means ample support is afforded to the weight of the animal without undue strain on any particular part. Although the kitten depicted in the photograph is rather a large specimen, it will be noticed how comfortable it appears when supported in this manner.

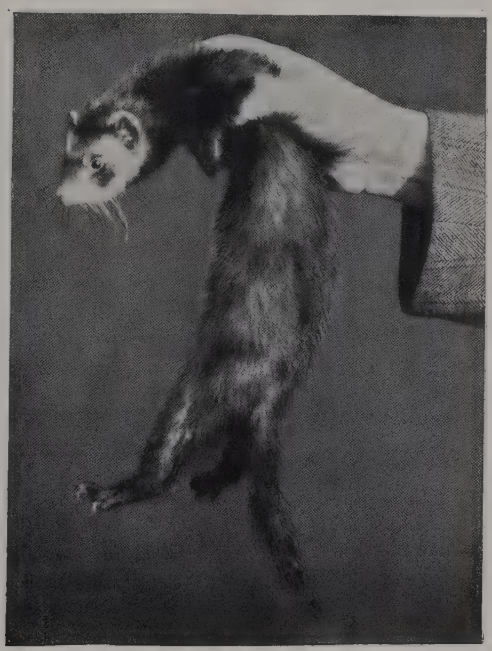
GUINEA-PIG.

Rabbits are notably the pets of boys, and yet how seldom it is that the little creatures are properly held by their appreciative but somewhat heedless owners. The popular method is to hold up a rabbit by its ears, but this, in the case of a heavy animal, is positive cruelty. Untold pain is caused when the entire weight of the body is supported only by the ears. Instead of being held in this fashion a rabbit should be grasped by the loose skin in the middle of the back. When taken up in this position it will remain quite docile and suffer no discomfort whatever.

Guinea-pigs, again, are favourite pets of boys. The illustration shows a vigorous specimen being held up by its owner in the correct attitude. The animal is grasped just behind the forelegs. Mice are



LIZARD.



FERRET.

timid, delicate creatures. They should never, as is so frequently done, be held up by their tails. It is a cruel practice, for it causes the tail to peel. The skin at the back of the neck should be grasped by the finger and thumb.

Ferrets are invaluable to gamekeepers, rat-catchers and others, but on account of their vindictive nature require careful handling if bites are to be avoided. Many gamekeepers grasp them firmly round the neck, but a better method is shown in the photograph on page 531. When a ferret is lifted preparatory to its being placed in a rabbit hole it should be grasped firmly round the back just by the forelegs. In this position it can be handled with impunity.

Lizards and newts are more out-of-the-way pets, but are very popular with some young people. The smaller varieties require care in handling to prevent injury. They should be held by the finger and thumb just behind the forelegs. As the larger varieties are much more vigorous (a specimen of this kind is shown in the illustration), they can be taken bodily in the hand and held as depicted.

The points to be borne in mind in the handling of all animals are gentleness and quickness. We are too apt to forget that animals are as sensitive to pain as human beings, and it should be the duty of everyone who keeps animals for pleasure or profit to learn how to handle them with the minimum of discomfort to the animals themselves.

J. H. Powell.

A VICTIM OF THE FROST.

THE GARDEN, ST. ANNE'S, DUBLIN.
From the Water-Colour Drawing by E. A. Rowe.

HOW TO KNOW THE WILD FLOWERS

By the REV. H. PUREFOY FITZGERALD, F.L.S.
With Photographs by HENRY IRVING

THE FLOWERS OF THE HEDGE-CLIMBERS—II

THE HOP

THERE are very few, I expect, who would place the Hop, the Fig and the Mulberry in the same family as the Stinging Nettle. To the casual observer there would be few points of resemblance, but, in fact, they are all very nearly allied. The Hop (*Humulus lupulus*) is one of the soft, green plants that depend on others entirely for support; the tips of the stem are very sensitive, and as the stem moves round, like the hands of a watch, with the sun, there is a great chance that this sensitive tip will come in contact with some means of support, and it will then begin to twine round it, from right to left, in a spiral. The flowers must be sought for about the end of July. These are of two kinds; the male flowers are produced in graceful, green panicles, each little blossom being composed of five pale yellowish green sepals and five stamens. A small panicle is shown on the lower right-hand side of the photograph. The female flowers are not nearly so numerous, and might be mistaken for undeveloped male blooms; the branches which bear these are leafy, and the flowers spring from the axils of the leaves, that is,

THE HOP.

from the point where the leaf-stalk joins the stem. These flowers are collected in small cones, each scale of which bears a female flower with two stigmas. After fertilisation—which takes place by the dispersal of the pollen by the wind—the scales develop and the cone becomes the ordinary "Hop." At the base of each scale will be found a small, single fruit, protected by little, golden glands; these contain a bitter substance, which prevents animals from eating them; the wings of the scales, as will be seen in the photograph, become sufficiently large to be caught and blown about by the wind, and so Nature secures the dispersal of the seed.

The root of the Hop is a perennial, but the stems die down at the end of every summer; the leaves, which are situated in pairs, are stalked and broadly heart-shaped in appearance, being deeply cut into three or five lobes, while the edges are toothed like a coarse saw. The whole plant is more or less rough to the touch, owing to tiny green spines which are situated on the stems and along the ribs of the leaves, probably in order to prevent

BLACK BRYONY: MALE FLOWERS.

BLACK BRYONY IN FRUIT.

snails, slugs and other vegetarians climbing up and devouring the leaves. In fact, we may consider that the Hop is a highly developed plant, as it has so many adaptations for protecting itself and for propagating its own species.

BLACK BRYONY

One of the most beautiful of our hedge-climbers is the Black Bryony (*Tamus communis*), with its long sprays of very glossy foliage festooning the bushes over which it climbs; its bright, shining heart-shaped leaves are sure to attract notice, and there are few leaves which are more beautiful. The lower leaves are generally larger than those on the upper portions of the stem, and are sometimes as much as six inches in breadth; all of them are heart-shaped at the base, and gradually taper to a point. The flowers are of two kinds and are borne on separate plants, a sure and certain way of procuring cross fertilisation. The male blossoms appear in long racemes, and are small and yellowish green; each one bears six stamens; the general appearance is well shown in the photograph. The female flowers are in much shorter racemes and are unattractive in appear-

FOLIAGE OF BLACK BRYONY.

ance, but towards the end of the summer these are succeeded by small clusters of green berries, which change to bright crimson in the autumn and are then objects of great beauty. These berries are very poisonous.

country. The name Bryony comes from a Greek word signifying very rapid growth, and in this respect also both plants are similar. Whereas the Black Bryony grows by twining itself spirally round the stems of other plants, the White

WHITE BRYONY, ON A JUNIPER BUSH.

The Black Bryony is the only representative we have in this country of the Yam family. Its roots are large and fleshy, and black outside (whence the name), inside they are white and full of very acrid starch. In olden days a decoction was made from these roots, which was supposed to possess great healing powers, and was especially used as a cure for rheumatism.

WHITE BRYONY

The White Bryony (*Bryonia dioica*) is no relation to the plant which has just been described; whereas the latter is one of the Yams, this is a member of the Gourd family (*Cucurbitaceæ*), but, like the other, it is the only representative of the family that grows wild in this Bryony raises itself by means of tendrils; these are sensitive and revolve in the same way as do the long shoots of the Hop, in their efforts to find a support round which they can twist themselves. The rootstock is tuberous, white and sometimes branched; the annual stems are very rough, being covered with small hairs which contain a bitter juice; they have a very sickly scent when they are dying. The leaves are divided into five or seven rather irregular lobes, of which the central lobe is the longest. As in the Hop and the Black Bryony, the flowers are of two kinds. The male, or barren, blossoms are collected, several together, in a stalked raceme, each flower being about half an inch across, and pale greenish yellow in colour, with dark green

veins. The female fertile flowers are generally to be found in pairs ; they are much smaller, and different in shape from the barren ones ; the berries, which may be mentioned "Travellers' Joy," "Old Man's Beard," "White Vine," and "Virgin's Bower." Its appearance when in flower and in fruit is so different

CLEMATIS IN FLOWER.

appear in late summer and autumn, are at first green, then yellow, and finally bright red ; they are very poisonous. The foliage is somewhat coarse and rough, but very pretty in appearance; it figures frequently in old Gothic carving. The plant is commonly called Wood Vine or Hedge Vine.

CLEMATIS

A plant of many names is the Wild Clematis (*Clematis vitalba*), amongst which that some might easily mistake it for two different plants, and they may readily be pardoned also for not recognising it as one of the Buttercup family (*Ranunculaceæ*).

We have dealt with twining plants which grow by twisting their stems round supports, and also with those that raise themselves by means of tendrils ; the Clematis is intermediate between these two, for it is a leaf climber. The leaf has a sensitive stalk, which revolves, and if it

happens to come in contact with anything, however slightly, the sensitiveness causes it to press harder against the object and gradually to twist itself round. In this way the plant is gradually raised and forces its way up to the tops of the hedges, where it has access to plenty of light and air. The flowers are of greenish white hue, arranged in loose bunches; there are no petals; for economy's sake, the sepals have arrayed themselves to resemble these. In late summer and early autumn, the carpels, or seed vessels, are very conspicuous, for the styles (the stems of the stigmas or female portions) grow into long, feathery awns; hence the name of "Old Man's Beard." This is a provision of Nature to assist in the dispersal of the seed, as the wind readily catches and spreads them in all directions. The stems are very woody and tough, and sometimes grow to an immense size and spread many yards in length; the leaves are pinnate, generally with five leaflets; these leaves were at one time dried and used as fodder for cattle.

This plant is found most commonly growing in chalky districts, although it is by no means restricted to this kind of soil; the fragrant flowers may be found from July to September.

H. Purefoy FitzGerald.

CLEMATIS IN FRUIT.

HOW TO KNOW THE BIRDS

By the REV. MAURICE C. H. BIRD, M.A., M.B.O.U.

THE RAILS, MOORHEN AND COOT

ALTHOUGH the Land Rail in summer and the Water Rail in winter are fairly common in suitable localities in most English counties, both birds are skulking and crepuscular in their habits; they are very loath to rise, seldom fly far when disturbed, and very difficult to flush a second time. They are therefore more frequently heard than seen, except when hard weather compels the Water Rail to leave the reedy recesses, or sedgy swamps of the marshlands, to seek a livelihood by haunting the roadside running ditches of the upland.

Photograph by J. Atkinson, Leeds.

LAND RAIL, OR CORNCRAKE'S NEST.

In sharp winters they sometimes frequent drains where farmyard liquid manure is allowed to run to waste, and probe the mud with their elongated, down-curved, brown-red beaks for small worms and lesser forms of animal life that rejoice in such a habitat.

The Water Rail is the smaller bird of the two, and much darker; the under parts are nearly black, but faintly barred with white, and the upper are olive-brown, each feather having a black centre streak. As to size, Water Rails vary a great deal. On November 13, 1894, I measured two, shot within a few yards of one another, one of which weighed 4 oz. and measured 10½ inches, with a wing expanse of 14⅞ inches; the other weighed 5⅞ oz., was 12 inches long, and its wings expanded to 16⅜ inches. Both were females. The Rails have no solid, decorative frontal shields such as are conspicuous features in the head-gear of adult Coot and Moorhen, but should opportunity occur to handle a Water Rail, note should be taken of the shiny black, horny, central points (Indian-club-shaped under the microscope) to the feathers on the crown of the head—a provision of Nature, shall we say, to protect the skull when the bird is gliding through rank, stiff, and rough leafed, close-growing marsh vegetation. For this purpose also its narrow body, with the ribs much compressed, is emin-

ently suited. Hence may have arisen the comparison "as thin as a Rail," for the narrowness of this bird was probably noticed, and the simile used, long before the days when sawn-out railings came into common use.

Photograph by Wm. Farren, Cambridge.

WATER RAIL'S NEST.

When a Water Rail is handled, attention should be given, too, to the diminutive wing-spur, most easily to be discovered in the black nestling. It is present in all the Rails, Coots, and Moorhens; in the Rails it is straight and comparatively blunt, but in the Coots and Moorhens it is curved and sharp, like a kitten's claw. Rails' feet are large and long, and are suspended in flight. The Water Rail has white under-tail coverts, and it flirts its short tail after the manner of the Woodcock and Moorhen. This bird occurs both in winter and summer, and, indeed, winters here more frequently than is generally supposed; but those that breed with us can only be found in the lowlands where the plough does not penetrate and the marshman's scythe is the only cultivator besides the much-worked drainage mill.

The Water Rail's nest is a large and heavy structure in proportion to the size of the builder, and is usually composed of sedge and reed leaves, sometimes semi-floating, but never resting on deep water. The eggs are milky white, spotted with pale lilac and pink markings; they are large, compared with the size of the bird, which, whilst settling itself down to incubate, does its best towards self-concealment by drawing closer around it the surrounding vegetation. In the Norfolk Broads district the noise made by the Water Rail during the breeding season is called "sharming"; it is something like a small, rasping screech, and I have often noted it more particularly after a sudden noise, such as the report of a gun, or the rattle of a quant knocked against the side of a boat, on a still, bright winter's day, just in the same way that cock pheasants will cackle after a thunderclap. It is difficult to reduce bird language to words; some people liken the Rail's notes to a grunt, others to a vibrating rattle.

The latter comparison is more nearly descriptive of the ventriloquial voice of the "creck-crecking" Land Rail, a bird of the pastures and corn lands, though it delights in dry marshes where insect food abounds. The happily named Corncrake does untold good in devouring the "Daddy-Long-Legs," or Crane-fly, the larvæ of which — called "leather jackets" on account of the toughness of their skins — do much damage to grass roots. So partial is the Land Rail to the perfect insect that I have shot more than one in a day so gorged with them that their legs have protruded from the bird's over-charged gullet.

Many birds seem to levy toll upon this

heavy-flying, defenceless and destructive insect. Starlings hover and glide after it with swallow-like flight, sparrows also take it on the wing as well as when it is settled, and all the crow birds are its inveterate enemies in every stage of

parts yellowish brown streaked with black, chestnut wing coverts and buff under parts, and beak somewhat compressed, but not elongated as in the Water Rail. It shuns the haunts of man, and rarely shows itself, though when suddenly

Photograph by F. T. Newman, Berkhampstead.

A MOORHEN'S NURSERY.

development. Although the Land Rail may feed as well as "crake" by night, it seems to be a provision of Nature that the perfect insect of the Crane-fly should hatch out from the chrysalis as a tender though ungainly nymph when most of its bird enemies are at roost.

We had a superabundance of "Daddy-Long-Legs" in the autumn of 1908, and at nine o'clock in the evening of September 13, with the help of an acetylene bicycle-lamp, I was astonished at the unusual sight of hundreds of them sticking out over half an inch above the grass—one at least to every square yard—emerging from their pupa cases over the whole surface of our tennis lawn.

The Corncrake, which comes to us in April and leaves in September, is a little larger than a thrush, with the upper

and unexpectedly disturbed its heavy, clumsy flight, with dangling legs, gives one an opportunity of observing, and wondering at the difficulty which so sluggish a bird must experience in migrating to and from Africa. It lives and nests on the ground; the eggs—sometimes as many as ten or twelve—are stone-coloured, spotted and splashed with red, much like small, light-coloured eggs of the Moorhen.

The black, red-pated Moorhen, with large olive green legs, and orange and scarlet garters, is not only the most common, but also the most confiding of our marsh and water birds. It is contented with any inland pond, however small the dimensions, for breeding purposes, and in winter may easily be tempted, by gradual feeding up, to frequent the neighbourhood of houses. Though gener-

ally met with by day in the near neighbourhood of water, the Moorhen travels some distance away from it at night. It makes its passage well up in the air, and its flight-note—"thuck, thuck"—provides a frequent puzzle to those who listen to the night sounds of Nature. Moorhens are very early breeders, and are very easy and amusing to watch after the young are hatched. They are double brooded, and a curious point in their domestic economy is the fact that the first clutch assists in the rearing of the second brood. A second nest or half nest is also sometimes built for a juvenile resting and drying place after the cradle in which they were hatched is deserted by the young birds. Though as a general rule Moorhens build a floating nest anchored to aquatic vegetation, a dry site is sometimes selected, and that at some height above water level; but, as far as my own observation serves, always in trees or bushes which overhang the water. Moorhens are practically vegetarians, and as they are very partial to grain, soon become accustomed to maize in coverts where pheasants are fed. They will frequently rest in trees during the day, those that are evergreen or ivy-clad for choice.

Photograph by J. Atkinson, Leeds.

COOT AND YOUNG.

Like the Rails, the Moorhen is averse to using its wings, and can make rapid progress on foot; it swims well, and is an expert diver, though it never remains long under water, or, rather, entirely submerged; for when one is seen to dive, if a careful watch be kept for a few yards around, the point of the beak protruded above water level beyond the nostrils may be discovered whilst the Waterhen, clinging with its very prehensile claws to the water-weeds, takes wind for a further submersion. When walking or swimming the Moorhen may be distinguished from the Coot not only by its smaller size, but also by its constant habit of head-bobbing as well as tail-jerking.

Photograph by J. H. F. Cay.
YOUNG COOTS IN NEST.

The latter bird is more slaty grey than black, and its forehead is adorned by an ivory white skin-patch instead of a red one; the beak is also, in the adult, a pure ivory white, and the bird is far more thickly feathered, and has a much more stumpy tail than a Moorhen, with no white under coverts. It is also wilder and much more gregarious, and not nearly so common or widely distributed; it requires a larger expanse of water for its less amphibious life, for although Coots often feed and pair on land, and nest amongst the reed-beds, they spend most of their time during the winter in large companies upon the open water, where they can keep a careful watch against danger. Two or three hundred Coots rising simultaneously from the water make an indescribable clatter as their rounded wings strike the surface, and their heavy, lobated feet drag through it for some yard or two before they can accumulate sufficient power to raise their bodies above the water line. But clumsy as they may look in flight, with rapidly vibrating wings and legs stretched out behind, they travel swiftly down wind when once well on the way.

Young birds are grey in the first plumage, with very light neck and under parts; the nestlings in black down, with orange-red, white-tipped, hairy filaments on head and neck, are curiously beautiful, and at this stage of their existence make some use of their wing-claw in scurring over floating water-weed.

Photograph by Wm. Farren, Cambridge.
A COOT ON ITS NEST.

Like the Great Crested Grebes, Coots seem to prefer reed-surrounded waters, amongst the stems of which useful and graceful plant their nests are usually to be found. They are large structures, which are raised in height when floods threaten the protectively coloured eggs, which are stone-coloured and peppered over with black markings; they closely assimilate to the fungus-stained over-yeared reed leaves, with which the nest is lined.

I write feelingly when I say that the eggs are thus "protectively coloured." I once invested a few shillings in order to save some Great Crested Grebes' eggs from being added as specimens to collectors' cabinets, and as an experiment I placed them in convenient Coots' nests—a proceeding to which the Coots did not object. Sad to relate, however, every one of those grebes' eggs was sucked by Grey crows, though many Coots' eggs hard by were left untouched, and were probably undiscovered by the destructive crows.

MAURICE C. H. BIRD.

THE GRASS OF THE WASTE PLACES

By MAUD U. CLARKE

With Photographs by HENRY IRVING

GIVEN some moisture, and any possible roothold that can be assimilated by these grasses, and there is scarcely any limit to where they will not spring up and beautify the place. In spite of rough regions, rough treatment, and scanty benefaction of any kind, they yet hold their own. The apparently barren region of the roadside can be really a land of choice possibilities for many such grasses, and compared with other places where I have seen them living and flowering, it is by no means a starved land. If there be one situation *par excellence* ugly, desolate, and far removed from the beauty of Nature, it is that hideous conglomerate of chaos represented by the site on which houses have been, or are in process of being pulled down in towns. Yet I have seen even there the Soft Brome on the rubbish mounds, just kept in countenance by stray plants of groundsel.

Decayed mortar is not bad plant-food, but the surrounding conditions are remote from the miracle of the flowering grass. The tufts of grey-green blades were the only clean and beautiful things visible in a smirched area of everything ruinous and depressing. I know the *Bromus mollis* can give cheer even to those grisly railway embankments that surround London. For there are embankments and embankments, of widely differing character, since those cutting through the chalk hills or red loam of the country are often nurseries for the plants after their own heart. In the grime of coal-yards, in the cracked paving of dubious streets, in the very teeth of the unnatural conditions of town life, the grass of the waste places creeps in maybe to cheer someone with eyes to see, and very certainly the sparrows.

But I would show the Soft Brome in better circumstances than these, for the Lop Grass, as it is sometimes called, is a true country roadside grass. It has there many pleasant neighbours surrounding it, such as the wild camomile, the company of thistles in variety, tall docks, or trailing mallows, with perhaps the white clover springing amongst it. It is a soft-leaved grass with twisted blades and soft hair covering the flower spikelets also, whilst the edges of the overlapping

SOFT BROME, OR LOP GRASS.

BARREN BROME.

WILD OAT.

WAY BENT.

glumes shine a polished silvery green colour. Although a very variable species, the closely compacted glumes and the glaucous green colour make it one easily to be recognised in one or other of its forms. It is an annual species, flowering from May to July, and varying from one to two feet high in general.

The Barren Brome (*Bromus sterilis*), another wayside grass, although quite distinct in appearance from the Soft Brome, possesses the botanical characteristics that place them in the same category. One of these is, that the leaf-sheath splits half-way down. The oat character is seen more distinctly in *B. sterilis*—*Bromus* being the Greek name for oats—since there are the long fine stems of the spikelets and the long awns extended from the glumes. The panicle of the Barren Brome is variable in length, measuring from six to sixteen inches. Bordering a grass lane in shelter of the hedges, I have seen it a very stately height, with long spraying panicle tossing in the wind very gracefully. It often springs up in patches at the edges of the open field paths, which is a favourite haunt of many of the grasses.

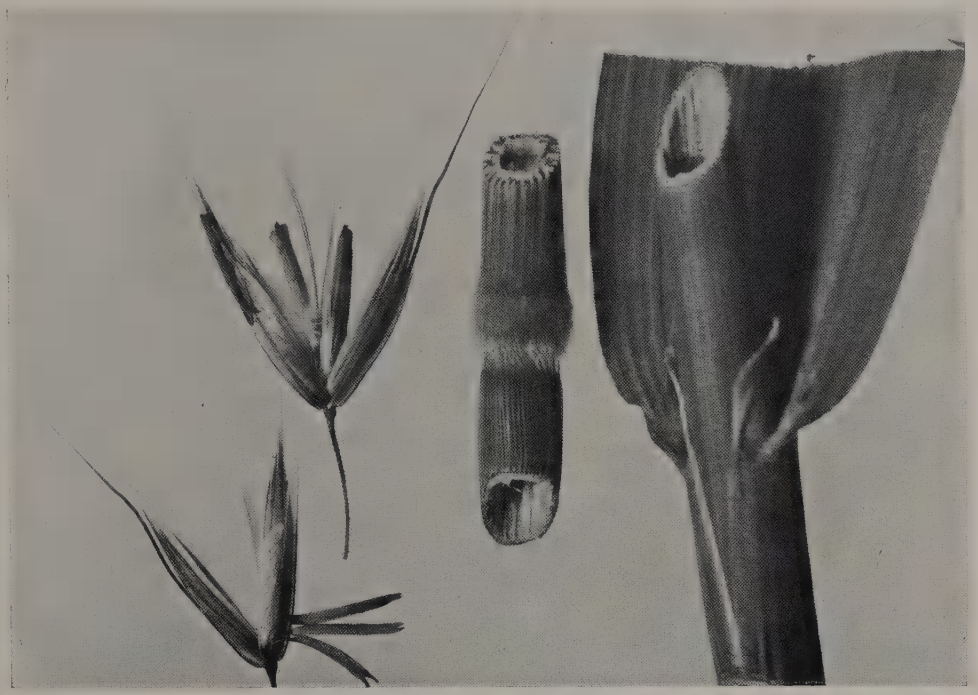
Perhaps as familiar as any is the *Avena fatua*, or Wild Oat, a stout grass with smooth stems, but with a minute growth of hair at the nodes or thickened notches. In the setting of the loose panicle, often as much as ten inches long, with the spikelets hanging on unequal foot-stalks, we see a close resemblance to the plan of the cultivated oat. It is often found in association with wheat and other crops, and with the wild poppy among the roots. In among the acres of turnips or swedes,

FALSE OAT.

WALL BARLEY.

the flare of the red poppy and silvery green of the Wild Oat is one of Nature's most happy combinations of effect. One can scarcely particularise the habitat of these grasses better than those of the "waste places," since they bears strong resemblance to *Lolium Italicum*, the Rye Grass of cultivation, a species having longer spikelets.

But the spike of the Way Bent may be a much reduced example of the illustration, perhaps less than six inches, but



ENLARGED DETAILS OF THE FALSE OAT.

are wonderfully ubiquitous. The Wild Oat will spring up through the dead dry accumulations of chaff in the rickyards or among the rusty lumber surrounding the blacksmith's shop with equal possibility. Its individual existence is only annual; the flowering, however, is maintained through June and July, the seedling plants becoming dispersed in equally promiscuous quarters.

But the grass of all others that can claim to be ubiquitous in any and every waste place, and in every odd corner that is left vacant by accident in places not waste, is the Way Bent (*Lolium perenne*), a perennial plant. In good quarters, where it has perhaps established itself among clover crops, it is quite a handsome grass, with as many as twenty-two spikelets crowding the stem. It then always of flattened form, owing to the spikelets being set edgewise upon the stem. In the cultivated species there is a wonderfully brilliant polish on the leaves, which flash in the sunlight like glass; a field of it rippling to the wind is a very beautiful sight. The vagabond variety grows in truth anywhere that is "waste." Not the hardest road bounded by stone walls but will at their junction show the Way Bent straggling in the dust. It pierces the mounds of road "metal" lying along the way, fringes the most trodden of foot-paths, suburban or otherwise, and seems independent of all adverse conditions. On the edge of the towpath it springs, but apparently not because of the proximity of the canal, but of the trampling of the track, the grinding of coal-dust amongst it, the

drought of the baked earth, and the general impoverishment of circumstance. In August heat it waves beside the parched field-paths, or lurks in dusty ditches at the roadside. Although it naturally has its better times of growth in moisture in the early part of the year, there seems the inevitable association of the Way Bent with hard times and dusty arid situations.

The False Oat (*Arrhenatherum avenaceum*) stands alone as a single British species, on account of the lower flower of each spikelet having stamens only, the upper ones being perfect, or possessing both stamens and carpel. In the magnified details given in the illustration on page 547, the lower of the two examples of the flowering spikelet shows the three stamens hanging from the lowest glume, that on the left hand of the group. It is specialised further by the long bent awn, the upper glumes being awnless, or having them expressed in abbreviated form. The magnified section of the stem shows excellently the hair growth at the node, as also the membranous ligule that terminates the leaf-sheath at its juncture with the blade in the right-hand illustration.

In the uppermost illustration of the spikelets, we see the feathery styles of the carpel projecting from the left-hand glume. The flowering stem can be as much as three feet high, with erect branching panicle of light green colour. The glumes have a beautiful polish that reflects the sunlight as the grass moves in the air; the stem is also polished, whilst the leaves are rather rough. It is a grass of the hedgerows as well as of the pastures and odd corners. It has a perennial rootstock, and flowers in June and July.

There is so strongly distinctive a look about all the Barley tribe, that the Wall Barley (*Hordeum murinum*) is quite familiar to most of us. The long, harsh bristles that tip the glumes throughout the entire length of the flowering head are practically identical in character. It is a coarse grass with rough leaves although smooth of stem, averaging ten to eighteen inches high, and of a strong bright green colour. As the name suggests, this species can live contentedly on the top of a wall with scanty moisture supply, but it can cover large areas of ground of the waste order.

At the foot of fences surrounding land adjacent to the towns, spreading by the wayside, tufting about the bald territory of the gas companies, or decorating the divisions of the country allotment gardens, the Wall Barley flourishes in any such places during its year of life. For it is only an annual plant, flowering through June and July.

Why it lacks the grace of the true barley and unmistakably suggests a coarse growth of grass, would be a little hard to determine. The formation of an individual flower-stem is carried out with the same finish, the same perfect elaboration of definite scheme as displayed by Nature always. Yet the combined effect of a colony of Wild Barley is unsatisfactory as a whole. One is driven to conclude that the impression is due to the situation as much as to the grass itself, since one's ideas can be evolved in complex fashion by a combination of circumstance.

It would be unreasonable to leave mention of these grasses of the waste places without mentioning the Couch Grass, whose right to existence has earned it the title of a most troublesome weed.

From a wholly different point of view, that is really an excellent character, for the plant's own standpoint is, determination to exist. The perennial rootstock of *Agropyron repens* may be a matter of deep disgust to the farmer, yet it is an indefatigable, indomitable conqueror of difficulties in the economy of Nature. One disjointed inch of that creeping root possesses enormous possibilities of propagation for the species. Roughly speaking, the Couch Grass has a resemblance to the *Lolium* family, although botanically separated on account of the spikelets being set against the stem on their rounded side and not edgewise. The grass varies from one to two feet, having hollow, shining stems.

MAUD U. CLARKE.

HOW TO KNOW THE REPTILES

By DOUGLAS ENGLISH, B.A., F.R.P.S.
Author of "Wee Tim'rous Beasties," "Beasties Courageous," etc.

THE ADDER, OR VIPER

With Photographs by the Author

IN my last article I touched on the feeling of abhorrence which is produced in many minds by the mere sight of a limbless reptile. Fear of the snake (it sometimes masquerades as reverence) follows the stream of history from its source. We may assume that long before history was written this fear was in the making. We may further assume, from its persistence, that it has justified itself.

It is open to question whether such a thing as *instinctive* fear exists. One school of thought holds that all such emotions as fear, hatred, love, and so forth are slowly acquired through the influence of example and education. Neither education nor example, however, can account for the tendency to acquire such emotions being stronger in one individual than in another, and the tendency to regard common objects of the country as the personifications of abstract ideas is common to civilised and uncivilised alike. It is to this that we must attribute the ophiolatry of the Babylonians and Egyptians, which no doubt gave impetus to the orthodox Hebrew conception of the serpent as the embodiment of evil.

Nor is such a conception fantastic. In "the way of a serpent upon a rock," his invisibility at rest, his subtle and insidious movements, his hideous and deadly attack, we have peculiarly sinister facts.

Science, however (unfortunately for herself), has little to do with imagery, and, from a scientific standpoint, we may only regard the serpent as a remarkable and extreme specialisation.

AN ADDER FULL FACE.
In this picture the chink in the rostral shield (centre of upper lip), through which the tongue is projected while the mouth remains closed, can be seen.

Everything points to the Order *Ophidia* (as we know it) being of comparatively recent origin. Perhaps the oldest existent types are found in the Boas and Pythons (non-venomous snakes), who retain some vestiges of hind limbs. The earliest known record of a *venomous* snake comes from the Miocene period.

As might be supposed from the absence of external limbs, the skeleton of a snake consists mainly of a skull and a vertebral column. Both vertebræ and skull, how-

ever, are highly specialised. The vertebræ, concave before and convex behind, form a succession of ball and socket joints, and thus combine strength with mobility. There is a limit to the mobility, however, which is secured by the interlocking in certain positions of the upper portions of successive vertebræ.

Each body vertebra has a pair of ribs attached to it, and these ribs, the distance of which from one another admits of considerable expansion, are fixed by their distal ends to the broad overlapping plates which cover the under portion of a snake's body. In a moving snake a wave passes from head to tail as the sharp hind edges of these plates successively engage and quit the ground. It is, of course, essential for this movement that a considerable portion of the snake's body should be in contact with the ground surface, and the snake obtains the path of least resistance by throwing his body into horizontal convolutions and gliding round, rather than surmounting obstacles.

UPPER SURFACE OF AN ADDER'S HEAD MAGNIFIED.

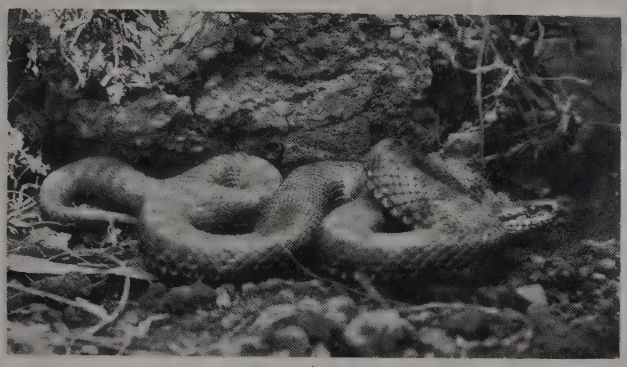
The principal plates are the frontal (*F*), the parietals (*P P*), and the supra-oculars (*S S*). It should be noted that the supra-oculars are separated by small scales from the frontal. In the Grass Snake and Smooth Snake, the supra-oculars and frontal are usually contiguous.

In explanation of the conventional drawing which represents snakes as moving in *vertical* rather than *horizontal* convolutions, I would hazard the following conjecture. It is well known that the earliest line drawings were in strict profile. Ancient art had no conception of fore-shortening. Suppose then (and this must frequently have occurred under, say, Rameses XXXII.) that an artist was commissioned to draw a snake. His first impulse would be to draw it, as he drew everything else, sideways. With a live model this could only result in a straight and stumpy snake. He would worry about the wrongness of his picture, and the critics would worry him, but at last he would have an inspiration, perhaps in answer to an appeal to the god Cneph. Why should he not cease to grovel on his belly, and, standing well over the snake, depict it from above? He would do this, and be delighted with the spirited result. A slight alteration of the head would complete the convention.

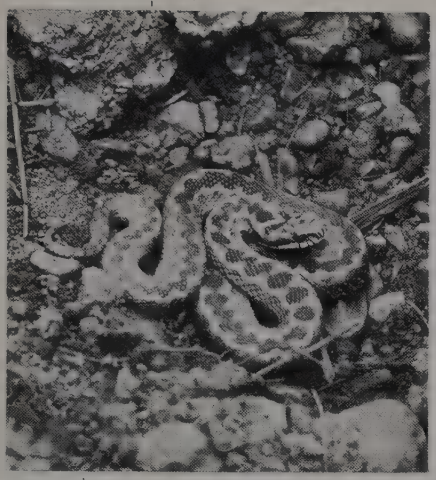
In all serpents the skull is modified to admit of an enormous distension of the jaws. Perhaps the greatest displacement occurs in connection with the mandibles. These, in addition to being widely separable at the chin point, articulate loosely with the movable quadrate bones, which in turn articulate with the elastic squamosals (*see* page 554). Further stretching occurs between the bones which compose the roof of the mouth, and the final "gape" is limited only by the elasticity of the skull muscles and ligaments. The necessity of some such specialisation for dealing with bulky articles of food is evident, for it must be remembered that a snake's teeth perform no masticating functions, but are employed solely to steady the food, while the snake works himself outside it.

Exigencies of space account for several curious features in a snake's interior. His windpipe reaches well forward in his mouth, and may even loll out for breath while the snake is dealing with a refractory meal. His forked tongue lies normally in a sheath beneath his windpipe. Only one lung (the right) is fully developed. The gullet is extremely long (some nine inches in the average Adder) and admits of at least the same distension as the mouth. A small but strong constriction separates it from the stomach, which is comparatively short (two and a half to three inches in the Adder), thick walled, and only slightly distensible.

One of Professor Leighton's interesting investigations on reptiles is concerned with the digestion of snakes.

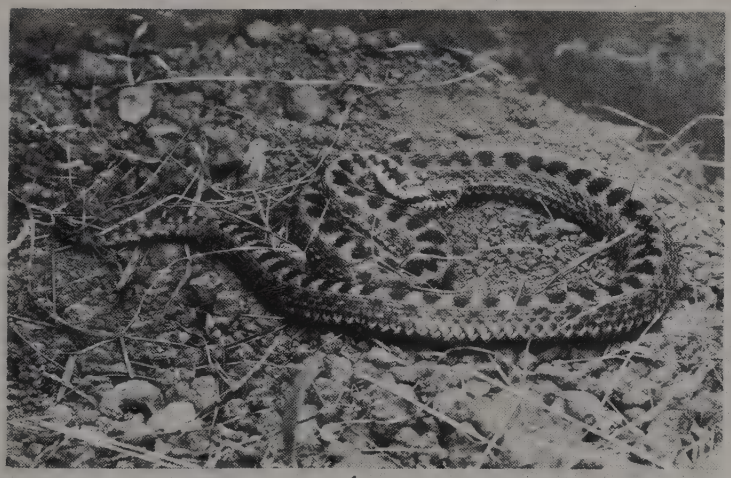


1



2

3



4

STUDIES OF THE ADDER.

No. 2 shows the small Red Adder; Nos. 1 and 3 the Common Adder in an old skin; and No. 4 the Common Adder immediately after sloughing its skin. The latter picture shows the characteristic attitude preparatory to striking, one large coil being thrown forward.

This appears to be effected by instalments, and it is likely, but not certain, that the speed of it can be controlled.

Having secured a tooth grip of his victim, the snake proceeds by slow degrees to push himself outside it. By the time he has accomplished this feat, the skin surrounding his gullet is stretched to such an extent that every scale on it is parted from its neighbour; and, should the snake be startled at this juncture, he will frequently disgorge his meal. Instance after instance has been recorded of frogs so disgorged, being apparently none the worse for the temporary inconvenience of being swallowed.

No digestion can take place in the gullet. The nutrition of the snake is, therefore, of necessity deferred until the portion of his victim first swallowed (in the case of mice this is usually the head) has passed from the gullet to the stomach. Here, as might be supposed, the main process of digestion is accomplished; but further digestion occurs in the intestine, and the percentage of actual waste per meal is extremely small. The interest of Professor Leighton's investigation lies in the suggested possibility that snakes can let digestion wait on appetite by retaining undigested food in the gullet for as long as they feel inclined. This would account not only for the lengthy intervals between snakes' meals, but also for their bulk. Of the latter, Professor Leighton gives an interesting instance. He killed an Adder which had swallowed two young water rats. The head of number one had reached the stomach and had been partially digested; number two, which was in the fore part of the gullet, had no signs of digestion on it. It is difficult to avoid the conclusion that this Adder had intended to provision himself for some weeks in advance.

An Adder's food consists of small rats, mice, lizards, and fledgling birds. It is not likely that he habitually expends poison on victims of this description.

The opening of his jaws does not necessarily involve pressure on the poison glands, and he can lower or raise one or both fangs at will. It is probable, therefore, that he reserves his poison for use in self-defence, or for dealing with some particularly large or refractory victim. The mechanism by which a snake's poison apparatus is controlled is exquisitely balanced. It differs in the various families of snakes; but in all the wounds inflicted is a bite, and the venom comes through or along the tooth which inflicts the wound.

The venom of Adders is secreted and stored in two pear-shaped glands (corresponding to the parotids in a human being) the rounded ends of which lie towards the back of his head. Usually, but not invariably, the presence of such glands causes the head of a venomous snake to appear flattened and broadened behind. Ducts lead from these glands to the fangs. In the case of some venomous snakes the fangs are grooved in front, and the poison travels down the grooves as the snake strikes. This is probably a primitive condition. In the Adder the lips of the external grooves have coalesced, and each poison fang consists of a tapering recurved tube the upper orifice of which communicates with the duct from the poison gland, and the lower orifice of which is, at its commencement, a little short of the actual point.

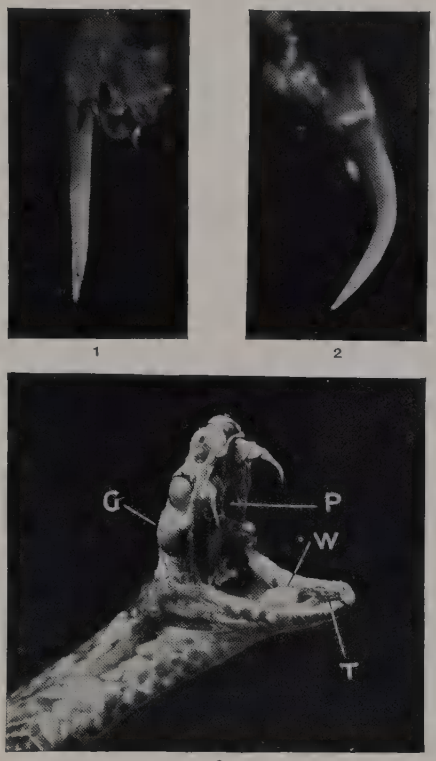
This "perfectly devilish contrivance," as Mr. Gadow puts it, ensures that the injection of venom shall be deep down in the wound, and that it shall have a clear run. The hypodermic syringe, in which, to avoid clogging, the point is bevelled so that the orifice shall commence a little short of the extremity, is a practical application of the same principle. In the case of the syringe a plunger expels the fluid; in the case of the snake equivalent force is supplied by muscular pressure on the poison glands.

The fore portion of an Adder's jaw (*maxilla*) in which the fangs are implanted admits of such displacement in an upward direction, that the fangs can be swung from a position in which their points are directed towards the reptile's palate, to one in which, though their points still curve backward, their main axes are nearly vertical. This ensures a dragging wound and a freer injection of the poison. The displacement (*see* page 554) is effected by linkage between the quadrate, the pterygoid, and the ecto-pterygoid bones, fixed pivots being

supplied at the articulation of the quadrate and squamosal, and the hinge of the maxilla.

I have already advanced the opinion that the full dose of venom is only discharged in cases of emergency. When an Adder strikes at man, or at some comparatively gigantic animal such as a hound or a sheep, his intention is probably to inflict the utmost possible harm in the shortest possible time. Many chances may, however, intervene to prevent the venom taking full effect. Hair or clothing may impede the force of the blow. The Adder may miss altogether, or may only get one fang home. Supernumerary fangs are often found in an Adder's jaw, and their object is held to be the quick replacement of a fang which has been accidentally broken. In several Adder bites which I have examined the separation between the punctures has been smaller than any possible separation between the fangs, and, making due allowance for the possibility of a second bite with the same fang, I incline to the opinion that there are, not infrequently, two working fangs on each side of the jaw, parallel to each other, and at a distance of about a millimetre apart.

It is generally agreed that when there is no question of securing food venomous snakes bite only in self-defence. Were Adders less protectively coloured we should hear of fewer accidents in this country, since the provocation to Adders, so far as human beings are concerned, is, as a rule, purely accidental. A child may be scrambling up a bank and put his hand on an Adder. Before he knows what he has touched he is bitten. A man may be fond of Adders, and expert in handling them. I have known one such desperate character, who could usually produce an Adder from his pocket in the warm months, and who, on chilly days, would frequently carry one between his vest and his skin, explaining that it liked the warmth! Sooner or later he will sit on one of his *protégés*, and then he, too, will be bitten. Yet Adders will submit to amazing provocation. A few years back the village boys used often to bring them to me, sometimes tied up in a handkerchief, sometimes clasped between two chubby hands ("'E *do* wriggle, master!"), sometimes swung by the tail. I remember how one triumphal procession made my blood run cold. A sturdy six-year-old held the Adder at arm's length, and strutted like a drum-major at the head of his companions to the chorus of the then popular ditty "He *can't* get at 'em." As he approached me he held the brute on high, so that its ugly face almost brushed his own; the other faces clustered round and—I was glad when I had that Adder safely caged.



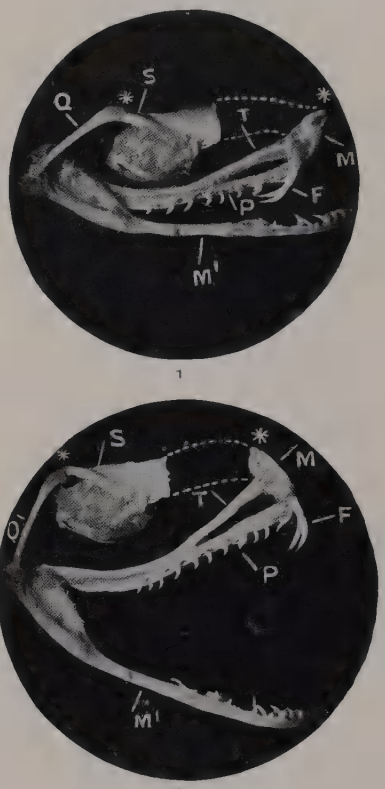
(1) and (2) FRONT AND SIDE VIEWS OF AN ADDER'S POISON FANG (× 5).

In (1) the orifice connected with the duct from the poison gland can be seen at the top of the fang, and the smaller orifice through which the poison is ejected close to the tip. The formation of a tubular fang by the coalescence of two lips of a grooved fang can also be traced.

(3) PARTIAL DISSECTION OF AN ADDER'S HEAD (magnified). The upper portion of the skin and muscles have been removed, showing the position of the poison gland G and the duct leading from it to the front of the fang. In the lower jaw the forked tongue T can be seen, and immediately behind it and overlapping it the opening of the windpipe W. In the upper jaw the position of the pterygoid teeth P well inside the fangs can be traced.

Yet it is doubtful whether the Adder *could* have struck in this position. So

far as my own experience goes, Adders invariably strike downwards, after a suitable disposition of the coils, a prolonged vibration of the tongue, and a warning hiss. Cases of Adders getting home above the level of the ankle-joint must, I fancy, have their origin in a spasmodic bucking action in an Adder which is trodden on, or otherwise very rudely disturbed. The ordinary action is like the flick of a whip.



PHOTOGRAPHS OF THE BONES OF ONE SIDE OF AN ADDER'S SKULL (× 3).

To show the mechanism by which the fangs are brought into a convenient position for striking. It should be noted that in order to secure a clearer view of the transverse bone T, a portion of the fore part of the skull has been cut away, and that its original position is indicated by dotted lines. It should also be noted that the two fangs visible both belong to the same side of the head, one being a fully developed and functional supernumerary. The star on the left hand marks the posterior end of the squamosal S, which may be regarded as a fixed pivot. With this bone, the quadrate Q articulates, and with this again the mandible M^1 articulates, and the pterygoid P, both of which carry small recurved teeth. Fixed to the centre of the pterygoid is the transverse bone T (ecto-pterygoid) the anterior end of which is connected by ligaments with the maxillary M. This carries the fang F (two fangs in this particular instance), and is hinged to the fore part of the skull at the point indicated by the star on the right, the second fixed pivot.

The mechanism is a linkage between the two fixed pivots indicated by the stars.

Fig 1 shows the fang at rest. In Fig. 2 the quadrate Q and the mandible M^1 have swung downwards, pushing out the pterygoid P. The transverse bone T necessarily comes forward with the pterygoid, and has rotated the maxillary M on its hinge, so that the fang F is "erected."

Deaths from Adder bite in this country are extremely rare. Two fairly recent instances are quoted in Professor Leighton's "British Serpents." In the first (June 2nd, 1893, Glamorgan) a boy eleven and a half years of age was seen professionally within three-quarters of an hour of the accident, and died within thirty-six hours. In the second (June, 1901, Cumberland), a child aged four years and eight months was bitten in the leg, and died three days subsequently. In this case it was some hours before medical assistance could be obtained. So far I have been, personally, fortunate enough to escape being bitten, but several cases of severe Adder bite have come within my experience. The primary symptoms are faintness (sometimes alarming faintness) and pain in the wound; the secondary, ulceration of the wound and a swollen condition of the limb (it is almost always the hand which is bitten), which may extend to the adjacent trunk—the symptoms, that is to say, of severe local blood-poisoning. One victim who was bitten near the wrist, and who felt the effects for a fortnight, described his experience as "much like vaccination."

Scientifically, snake-poisons are termed "venins," and have been assigned to the group which embraces bacterial poisons, such as those of tetanus and diphtheria, scorpion poisons, and deadly vegetable poisons, such as ricin and abrin.

The complexity and variability of snake-poisons is a serious hindrance to the discovery of any treatment by which a human being may be rendered immune.

So far as this country is concerned, we may congratulate ourselves that the vast majority of snake bites occasion no more than a few days' discomfort. In view, however, of the two pitiable instances to which I have already referred, I feel I need make no apology for indicating the treatment which doctors advise. Since snake-poison powerfully depresses the heart, the first object is to prevent the venom getting into the circulation. Much, of course, depends on the position of the wound. If the Adder's fang happens to

pierce a vein the venom will be in the circulation almost instantaneously, and little can be done beyond keeping up the heart's action by stimulants. The old-fashioned remedy was to make the patient drunk, or to try to. It is, of course, preferable that drugs like strychnine or sal-volatile should be employed; but as it is extremely improbable that anything of the kind will be at hand, small successive doses of strong alcohol will naturally and properly suggest themselves. Should the bite, as is far the most likely, miss a vein, the venom will have to pass through the lymphatics and blood vessels before it reaches the general circulatory system. In this case there will probably be time to tie a ligature (rubber for choice, a twisted bicycle tube for want of anything better) above the wounded part, and to check the inflow of poison by a free incision into the wound or wounds.

The local application of powerful oxidisers, such as permanganate of potash, has been suggested on the ground that such oxidisers destroy or weaken the action of the venom. It must be remembered, however, that these are not selective in action, and that they will oxidise anything oxidisable with which they come in contact. The remedy in this case might be worse than the disease.

Adders are generally distributed in Great Britain, though some counties appear to be especially favoured. It is generally supposed that they prefer hot, dry situations. In the sense that they enjoy heat this is true, but they do not enjoy the sun-bath which appeals to the lizard. I remember my surprise at finding an Adder, whose glass-roofed cage I had thoughtlessly left where the sun could reach it, killed by the heat, while a common lizard, who kept him company, seemed none the worse. On the downs Adders generally retire from view during the hot hours of the day, and in the woods in this district (West Kent) such Adders as I have encountered have been almost invariably in the shade of gorse or bracken. A gorse bush which sweeps the ground is a likely place for an Adder's cast-off skin.

The average length of the mature Common Adder is about twenty inches, an Adder two feet long being very large, and anything over that a giant, or, rather, giantess, for exceptionally large snakes are almost invariably females. The Red Adder, which Professor Leighton seems inclined to consider a distinct species, is decidedly smaller. None of the three specimens which I have obtained has been over a foot, and all of them were decidedly more rectangular in section than the common type. The markings of the normal Adder are highly characteristic, and serve at once to distinguish him from either of the other British snakes. The most prominent feature in his coloration is the zigzag black line on his back, whose re-entrant angles generally include black spots. In the Red Adder the zigzag is terra-cotta on a brick-red ground. The course of this line can be easily seen in some of my

THE RED ADDER.

This well-marked variety apparently never exceeds a foot in length (the specimen photographed was eleven inches). Its coloration consists of two shades of terra-cotta. It seems to be more square in section than the common type—and, according to most observers, more vicious!

photographs. In others, which I have purposely included—the function of zoological photographs being, in my judgment, to afford a standard of recognition—it is not so evident. Several causes may account for its being badly defined. The Adder may have an old skin (snakes slough several times in the summer); it may be a female or an old male—in both cases the markings are obscured; or, it may be an example of melanism, which is a comparatively common phenomenon in Adders.

In addition to the zigzag, Adders display a characteristic V-marking on the "nape" of the neck. It is irregular in shape, but in one form or another it seems to be invariable, and so challenges comparison with the V on immature Slow Worms, which is also the fore-end of a zigzag.

To the observations (not my own) that Adders produce about a dozen young at full time, in membranous envelopes which rupture at birth, and that the young are six to eight inches in length, I may perhaps be permitted to add my own answer to the question—Does the Adder swallow her young when danger threatens them, and disgorge them when danger is past? This is a highly controversial subject, and the state of the controversy may, I think, be fairly summed up as follows: If the question were at the present moment to come before the courts, and there were ranged on the one side scientific sceptics who denied the possibility of the occurrence; and, on the other side, believers (there are plenty of them, and honest believers at that) ready to swear that they had seen such an incident occur, and that they could not have been mistaken, the judge would be compelled to sum up in favour of the believers. Professor Leighton has proved that the Adder's gullet is sufficiently capacious to contain the brood. He has not touched on the scrimmage at the entrance, and it is the consideration of this which compels me, with all reluctance, to range myself on the side of the sceptics.

DOUGLAS ENGLISH.

THE STORY OF A SNOWFLAKE

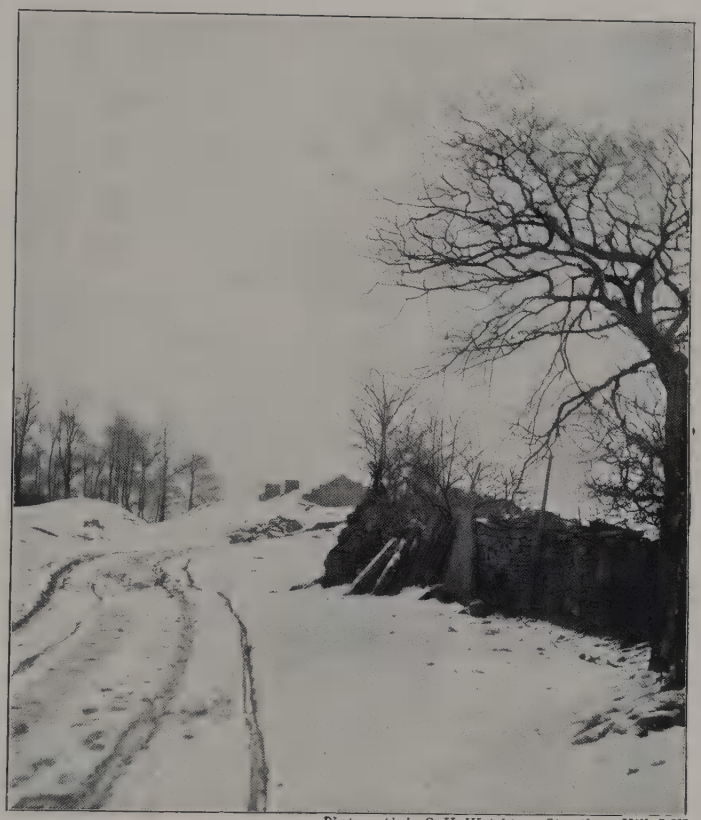
By J. LOMAS, F.G.S., A.R.C.S.

OUT of doors the air is chilly and raw, and the leaden sky promises an early downfall of snow. We turn indoors for comfort and warmth, and fall to contemplation. The kettle is on the hob, and from its spout dense clouds are issuing. They are scarcely formed before they evaporate and become invisible.

Without, snow has begun to descend, first as tiny sparkling stars, then as scattered flakes, and now large, curling, downy flakes darken the air. What a contrast within and without! Yet when we consider the two operations referred to more closely we find them to be related, and that one is necessary to the other.

The steam which has been dispersed into the air of the room, though lost for a time to our senses, can be recovered. Place a tumbler of cold water on the table. The exterior gradually becomes dimmed, and in a little while drops of water trickle down the sides. The fact is, a certain volume of air is only capable of dissolving a limited amount of water vapour, and the quantity depends upon the temperature. Cold air becomes saturated with a small amount, while warm air can hold more. So the cold glass chilling the air immediately in contact with it reduces the power to keep the vapour in the invisible state, and the excess is deposited as tiny drops of liquid. In place of the tumbler of water we may substitute a vessel filled with snow or, still better, a mixture of snow and salt.

Then, in place of tiny drops of water we find a white sparkling rime encrusting the exterior of the vessel. With a magnifying glass we see that the rime is not a shapeless powdery mass, but each tiny white speck has taken a definite shape, like a six-sided trumpet attached by the narrow end to the sides of the vessel, and the mouth opening towards the room. A simple experiment which anyone can perform will help us to understand better the operations which have taken place. If a tiny pinch of a soluble substance such as alum is dropped into a tumbler of water it dissolves and is lost to sight. More may be added with the same result. But at last a stage is reached when no more will dissolve, and the water is said to be saturated with alum. If we add more it only sinks to the bottom. Now warm the solution and the undissolved alum will disappear. Like the air, its power to absorb increases with the temperature. If now we allow the solution to cool, the excess of alum will return to the solid state. But we notice a remarkable change. We put in pieces irregular in shape, they reappear as crystals of regular form.



Photograph by S. H. Wrightson, Streatham Hill, S.W.

"THE FALL HAS CEASED."

Adverting now to the problem which first engaged our attention, we see that the air receives water-vapour from ocean and lake evaporated by the sun's rays, just as the fire disperses the steam into the room. Over the sea, especially in tropical climates, so much is absorbed that the atmosphere is practically saturated. Winds blowing from the sea carry inland air containing enormous quantities of vapour. When their progress is intercepted by mountains they are compelled to take an upward trend, and an altitude is reached where the conditions of temperature will not permit of their retaining all the moisture brought from the sea. The excess returns to the liquid state, and tiny globules of water are formed which remain suspended in the air as a cloud. The droplets do fall, but very slowly, and reach the earth as a drizzle. But if a wind or some other disturbance causes them to collide and coalesce into bigger drops, they fall as rain. If now the temperature should fall very low and the globules become too cold to remain in the liquid state, each little sphere of water will freeze into a minute crystal of ice. The form it takes is not haphazard, but is a clear, glistening, hexagonal plate. When dealing with the alum crystal it might have been mentioned that if left in a suitable solution it will continue to grow. No limit can be put to its size if sufficient food is supplied. So our ice crystal still has the power of extending

its borders; it continues to draw the invisible vapour from the air and builds it up into a symmetrical structure. If one part of the crystal has an advantage over another, growth may take place more rapidly at such a place, but still the original plan is followed, and no departure is ever made from the characteristic form it received at its birth. It would take too long to demonstrate, but it can be proved that a hexagonal plate, abstracting material from the surrounding medium, will grow more rapidly at the angles than in the middle of an edge, and so in an ice crystal there is a tendency for spicules to grow outwards from the six corners. In this way we arrive at the star-shaped flake so characteristic of snow. On a still day, during the first few minutes of a snowfall, we can often catch these beautiful stars on a coat sleeve or other cold object, and examine their wondrous forms. Although they never vary from the typical six-rayed type, they present an infinite variety. Sometimes the rays are simple rods of ice, at other times the rods themselves act as centres of growth and secondary rods shoot out like branches from a stem. Such outgrowths always make an angle of 60° with the primary rod, and thus preserve the hexagonal symmetry. From the secondary rods other branches may spring, and on the original foundation structures may be built up which, although subject to the control of forces, possess characteristics of their own. The ice stars are so fragile that when they collide, the minute rods are broken, and the larger snowflakes are as a rule composed of matted aggregates of fragmentary spicules.

Photograph by S. H. Wrightson, Streatham Hill, S.W.

"ALL WITHOUT IS SILENT AND BEAUTIFUL."

So far our contemplation has led us to trace the history of a snowflake from its birth in the ocean to the time when it descends to the earth.

By this time the fall has ceased, the clouds have dispersed, and the winter's sun, catching the smooth, bright facets of myriads of crystals, reflects its glory in countless sparkling spots of light. The boughs of the trees are drooping to the ground under their heavy load; the tender plants, snug beneath a blanket of snow, are protected from the keen frost, and all without is silent and beautiful. The wind, finding a gap through the hedge, and gathering strength as it converges through the narrow opening, has swept a clear course and drifted the snow to the parts away from its direct line of movement, and even now the powdery crystals are carried along, curling in eddies, and heaping themselves up into smooth ridge-topped masses. We note when the current meets an obstacle like a wall the material does not accumulate against the obstruction, but forms a ridge separated by a clear space, some little distance from the obstacle. If we watch the progress of the snow we shall see it moved up the slope of the drift, and when it reaches the crest it is carried forward like a puff of smoke, only to be driven back again by the current of the eddy which circles round on the lee side. It is clear that the snow will find a resting-place where the force of the current is insufficient to carry it in suspension, and such a place is found where the onward current and backward eddy meet and neutralise each other.

We have seen that without heat snow could not be formed. The sun spends its energy in changing the water of the ocean into a vapour. What becomes of this energy? It cannot be destroyed. Hence immediately after a fall of snow we feel an appreciable rise in the temperature due to the disengagement of the heat energy stored up in the vapour. On the other hand no air is so raw and piercing as a thaw wind. It is giving back to the snow the heat necessary for its dissolution.

We do not care to follow the story of the snowflake through the processes of destruction to its final return to the bosom of its mother ocean. It is never pleasant to dwell on the decay and death of the beautiful.

J. Lomas.

HOW TO KNOW THE TREES GROWING IN BRITAIN

With Notes, descriptive and photographic, for their Identification in all Seasons of the Year

By HENRY IRVING

THE HORSE CHESTNUT THE LIME

THE HORSE CHESTNUT

IT is a pity we have not a more suitable name for this tree. It has distinctive character enough to merit other than a borrowed title, and the somewhat depreciatory epithet is wholly undeserved. It ranks as one of the noblest of our trees. Having a rather formal outline, it is seen at its best in the massed group, or in the long line of the wide avenue; but it is welcome anywhere, and anyhow, in our landscape—the embodiment of a strenuous and noble life. It has also marked decorative quality, varying according to season, but never absent, and not merely

HORSE CHESTNUT IN WINTER.

HORSE CHESTNUT IN SUMMER.

COMPOUND LEAF OF THE HORSE CHESTNUT.

with respect to the tree as a whole, but in all its minor details.

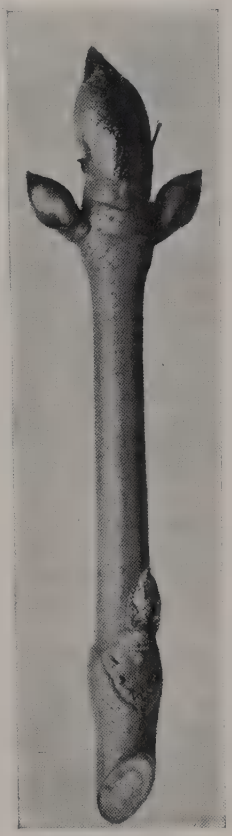
In *winter* there is strong suggestion of determined vigour in the upgrowth of its firmly planted stem ; in the outgrowth of its ordered branches ; in the wave-like progress of these, rising, flowing over, and rising again, or curving away upwards, thrusting their well-varnished and handsome buds into the open air and light.

In *spring*, in the earlier days, these buds, opening their brown outer scales, become suddenly more conspicuous in coating of creamy green. Those that are terminal, in particular, stand forth as myriads of candles on myriads of steady branchings, and seem to need but the touch of flame to make the whole tree one great illumined candelabrum. But another aspect is first assumed. From every bud flow out and overflow, as fountains of living verdure, the emerged leaflets, downward pointing. So they hang pensive for a while, till all the tree becomes as a green cascade. This is but Nature's pause. Slowly, steadily, each separate leaflet straightens itself out, seven leaflets to a single leaf, spreading open-handed, horizontally, and, as it were, upholding a central spike, which becomes a spire, and then the expected flame. So myriads of flames illumine the tree all over, spreading along and over all neighbouring kindred trees, flowing along the lines of the broad avenue, from base to summit, from end to end, noblest expression these islands can show of exultant vitality in the year's wealth of blossoming.

In *summer* there is again a pause. Masses of deep green build up the shapely pyramid of growth, all overlaid with patterned ornament in the varied tessellation of the symmetrical compound leaves which are so carried and fitted as to yield a wide and welcome shade.

In *autumn* there is new display. Great

HORSE CHESTNUT : THE FALL OF THE LEAF.



HORSE CHESTNUT TWIG AND BUDS.

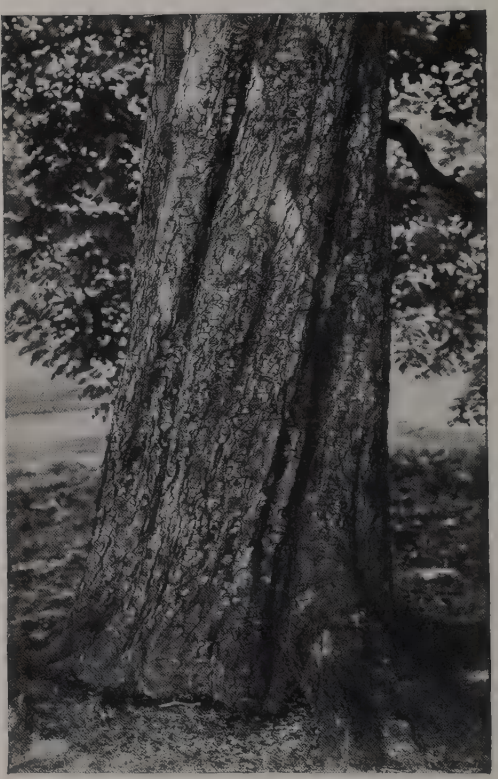
range of colour, varying according to the season, from clear yellow to rusty brown, spreads itself over the whole tree. The clusters of spiked fruits, passing from green to brown, perhaps open on the tree, often fall to the ground with a thud to open there, exposing the brilliant seeds.

The *bark* is moderately smooth but scaly. The *twigs* are stout, as is needful, since they must support great weight of leafage. The *buds* are arranged, as those of the maples, in opposite pairs. Enclosed in stout scales, they are further protected by a thick coating of varnish. The *leaf-scars* are large, light in colour, shield or hoof shaped, depressed as if branded into the substance of the twig. They show from seven to nine leaf-traces.

The *leaves* are compound, having usually seven leaflets. Each leaflet is of large size, rounded near the apex, to which it tapers suddenly, ending in a point, narrowing gradually to its junction with the stalk. A single compound leaf may measure as much as twenty inches across, and be supported by a stalk nearly a foot long—an admirable sunshade. In the fall the several leaflets, as with the ash, often separate singly, leaving the long stalk still attached to the tree.

The *flower cluster* is pyramidal on a central branched stalk. The flower petals are white, with markings of yellow and splashes of red and purple, crisp and crimped. The stamens, when mature, project, curving upwards, and are tipped with red. Cross fertilisation is provided for. In some flowers only the stamens mature, in others the stigma only, whilst, in those that develop both, the stigma is receptive before the stamens yield their pollen. Only those near the base of the cluster produce fruit. In each flower is good store of nectar so disposed as best suits the convenience of the humble bee, whose services are thus requisitioned for the conveyance of the pollen.

The *fruit* is a rounded prickly ball. It opens along three lines, exposing one to



TRUNK AND BARK OF THE HORSE CHESTNUT.

three large seeds, rounded, richly coloured, polished and veined, as jewels embedded in pillows of creamy satin.

THE LIME

The Lime, or more correctly the Linden, also lays great claim to our regard. Its nobility as a tree is as marked as is that of the Horse Chestnut, but of a less sturdy nature. It may stand alone, embodiment of gracious stateliness. It is, however, seen at its best when associated with

others of its kind to form the arched avenue, making covered way from the wide park-land to some "stately home," or leading up to the great cathedral. With equally fitting and more gentle grace it is often found roofing the path that joins lych gate and porch, in the approach to some rural house of prayer. For there is about the Linden tree a subtle element of sympathy, that is quickly responsive to what is deepest and highest in our human feelings and interests.

In *winter* this tree, with tall central column, bearing abundant and slender branches and twigs, can scarcely be mistaken. The lower branches often present an angular, or elbowed appearance. The tree margin shows close-set, fine division and interlacing. The base of the bole is frequently beset and hidden by crowds of shoots. The twigs and buds, more brightly red than those of any of our larger trees, give to the Linden at this season a glow of warmth. In *spring* this colour deepens with the increase of sunlight; but not until the year is well advanced do the buds expand, putting forth their drooping canopies of lustrous green.

LIME IN WINTER.

Not until *summer* is here have the new shoots expanded, bearing, horizontally, their two rows of fully opened leaves of cheerful green. And not until midsummer do the flower buds appear, beneath the still protecting sprays of foliage, in little ranged groups, as pearly pendants; opening out, under awning of spread fairy wings, into sweet bell clusters, whose tinkling might be audible to fancy but for the all-pervading other melody, of insect wings and insect voices, stirring the scented air to incalculable vibrations.

With *autumn* changes quickly supervene, for the Lime is of tender nurture. Leaves soon begin to yellow over; fruits formed, but with us seldom ripened, sail away, bearing no promise with them, their high purpose frustrated under hard circumstance. By mid-autumn the Limes are bare, gleam of twig and bud alone abiding out of all their short-lived fairy frolic.

The *bark* is but slightly roughened into narrow vertical furrows. The *twigs* are cylindrical, and take a zigzag course. In colour they are a brilliant red, merging into greenish grey. The *buds* are arranged alternately on these; they are stout, red as the twigs, and bulging on one side.

LIME LEAVES.

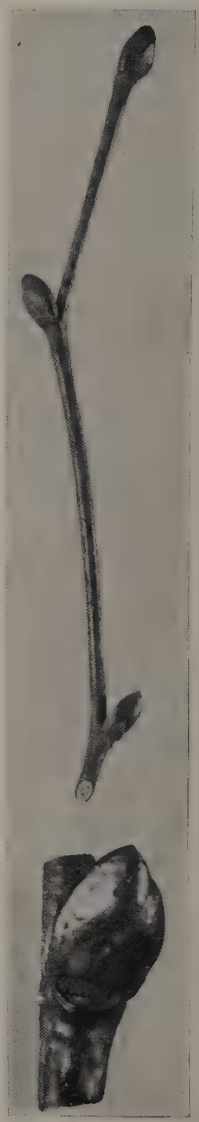
The *leaf-scar* is crescentic, and has three curved leaf-traces.

The *leaves* are broadly heart-shaped, with one side somewhat enlarged. They have a single midrib, with branching side-ribs. The lowermost of these side-ribs, strongly developed and themselves branched along the under side, start at the point of junction with the leaf-stalk. The margins are regularly and sharply toothed, except in the depression of the base where are no teeth.

BOLE OF LIME NEARLY HIDDEN BY ITS OWN SHOOTS AT THE BASE.

The *flowers* grow in a small branched cluster. This cluster depends from the centre of a specialised leaf (or bract), which overhangs like a protecting wing. This, being light in colour, helps to make the flower group more conspicuous. Each flower has small petals, yellowish white, and crowds of elongated stamens. The stamens mature and shed their pollen before the stigma is receptive. Hive bees are the chief agents in conveying the pollen, and with the Lime in bloom comes to the bee-keeper one of his chief harvests.

The *fruit* is a small cluster of rounded nuts, still attached by its main stalk to the centre of the overhanging bract. The cluster comes away whole, together with the bract, which now serves as a wing, or sail, in aid of flight.



TWIG AND BUD (ENLARGED) OF LIME.

There are three chief varieties of this tree grown in Britain, respectively described as the small, the intermediate, and the large-leaved Lime. This may be taken here as sufficient indication of their most distinguishing feature. That with intermediate sized leaves is the kind most common with us.

HENRY IRVING.

COTTAGE AT ROUNDHURST.

From the Water-Colour Drawing by Sutton Palmer.

A DYKE WHERE PIKE SPAWN.

BRITISH FRESH-WATER FISH AND THEIR HAUNTS

By WALTER M. GALLICHAN

With Photographs by Mrs. C. G. GALLICHAN

PIKE AND PERCH

NO fish of prey that haunts fresh water is so feared by other fish as the Pike. Its voracity is extraordinary, and it will not even spare the weaker members of its own family, while its dietary ranges from aquatic birds to the fresh-water shrimp. Many are the stories told of the ravenous nature of the Pike, and within my own experience are many instances of its almost omnivorous instinct. Among the live creatures which I have known to fall victims to its hunger are a mole, frogs, young moorhens, flies, and earthworms. There is scarcely any bait used by anglers that has not been taken at one time or another by Pike.

Its depredations among fish of all kinds make the Pike a very undesirable denizen of salmon and trout rivers. This lurking terror of the waters is detested by everyone concerned in the preservation of streams that breed game fish; and in trout preserves the net, the snare, the trimmer, and the fishing-rod are continually employed to check its increase. But extermination is well-nigh impossible, even in the most-closely protected rivers and lakes, as Pike possess great power of surviving in the struggle for existence. In rivers, such as the Thames, Lea, and Trent, Pike are not regarded as pests, but are accorded all the rights and privileges of their companions, the bream, barbel, roach, and perch; and the

taking of Pike during the breeding season is considered an infraction of fishery laws, and an unsportsmanlike misdemeanour in all waters that are not sacred to the salmon and trout.

The Pike is of the family of the *Esocidæ*, and its scientific name is *Esox Lucius*. From Lucius, the old name of the fish, the Luce, used by Walton and other writers, was no doubt derived. In the South of England the fish goes by the name of Jack, and in Scotland it is the Pick or Gade. It may be noted that Shakespeare does not use the ancient name of Luce, for he makes Falstaff say: "If the young dace be a bait for the old pike, I see no reason, in the law of Nature, but I may snap at him."

Photograph by F. Franklin Pike.

HEAD OF A PIKE, 28½ LBS., CAUGHT IN THE SEVERN, MARCH, 1907.

The pairing season of Pike is in February and they spawn in March and April. In former times it was believed by several writers on fish that Pike were the product of spontaneous generation. Izaak Walton seems to have credited this fable, when he remarked: "'Tis not to be doubted but that they are bred, some by generation, and some not." That Pike pair and reproduce themselves after the manner of other fresh-water fish does not need assertion. In early spring the sexes may be seen in company, selecting places for spawning. They resort to quiet, reedy backwaters, tributaries, and dykes.

Young Pike of a few inches in length soon begin to prey upon the fry of other fish, and where food is plentiful they grow rapidly. "The tyrant of the flood," as Pope calls the Pike, attains a great weight in some waters; and the literature of angling abounds with accounts of monsters captured from the rivers of Eastern England, from Scottish lochs and Irish loughs. In Wales, fish of this species are rarely taken over fifteen pounds in weight; but such are found in a few lakes, in parts of the Dee, and in private ponds. Pike are not indigenous in Welsh waters. They were probably introduced into Bala Lake some centuries ago, and the mere is now plentifully stocked with them. A specimen of twenty-five pounds has been recorded as caught from this lake. Indirectly, I was the means of providing a nineteen-pound Pike for a Bala fisherman. While trout fishing, I was accosted by a gypsy lad, who said that he had seen a big Pike, and wished to obtain a bait with which to fish for the giant. He was without any small hooks, so I gave him some, and he took a Perch of about a pound, on a worm. With the Perch he fished for the Pike, and brought it to the bank soon after I left the lake.

A twenty-pound Pike is esteemed a prize among anglers, but fish of over twice that weight have been captured in British waters. A writer with the pseudonym of "Ephemera," *i.e.* Edward Fitzgibbon, says: "I believe the largest Pike ever caught in the British Isles was that caught

many years ago, the weight of which was about ninety-two pounds, in the river Shannon, by some visitors at Portumna Castle, the family seat of the Marquis of Clanricarde."

The biggest Pike that I have ever handled was one of sixteen and a half pounds which I gaffed for my cousin, Mr. C. W. Pike, from a pool in Worcestershire; while my own "record" Pike weighed ten and a half pounds, and was caught from the Dee above Corwen. In the Thames and Kennet I have seen Pike of quite twenty pounds weight, basking near the surface of the water in the early summer; and when skating upon very transparent ice, on a lake in Berkshire, I saw an enormous Pike, carrying in its jaws a fish of its own species, weighing about five pounds. The Pike was so encumbered by its victim that it could only swim with difficulty. Edward Jesse relates that a keeper in Richmond Park sent him a Pike of about seven pounds, which had died through endeavouring to swallow a Pike almost as big as itself. It is said that these fierce and rapacious fish will attack a dog when swimming, and there are one or two instances of Pike biting the legs of boys while bathing.

A glance at the illustration of the head of a Pike on the opposite page will show with what a powerful jaw and huge mouth the fish is provided. The head is cruel and sinister, the jaws armed with many sharp teeth, and the throat is capacious. Adapted in colour to its surroundings, a Pike will lie among the weeds of a stream without attracting the eyes of the passer-by. But those accustomed to watching fish can often detect a lurking Pike, lying motionless as a log, near the bank.

Except when impelled to range by hunger, or when in search of a mate, Pike resort to the cover of weeds or haunt the deepest pools. In the Norfolk Broads they enter the dense beds of reeds surrounding the water, and remain there in close hiding. Anglers sometimes expel them by means of dogs before fishing for them in the open water.

WHERE PIKE FEED: EVENING.

Pike are not sociable fish, and Walton describes them as "solitary" and "melancholy." They select feeding-places, and guard them jealously from other Pike. In streams they often make excursions, especially towards evening, into the shallows, where they pursue small fish. When a Pike is questing for food, its whereabouts is frequently marked by a swirl or a splash of the water, and the leapings of the dace and bleak, upon which it has murderous designs.

When rivers are ill-provided with harbours among weeds, Pike usually haunt the deep water; but they will lie in a foot or two of water if there is ample cover. They dart at a passing fish, seize it crosswise, and hold it for a time before swallowing it. In the old days of "gorge

PERCH FISHING IN THE WEY.

fishing," anglers used to give Pike from five to ten minutes before "striking" the fish; but in the modern mode of fishing with snap-tackle, the Pike is struck a few seconds after taking a live bait.

Pike appear to feed greedily at times, and then to fast for a day or two. Frost sharpens their appetite, and they are very hungry after the spring spawning period, when they return to the main river, lean, dull in colour, and unfit for the table. The rapacity of the Pike is well expressed by the Welsh name of the fish, Blaidd y Dwr, the Water-Wolf.

The Perch is one of the handsomest of our river fish, and has the merit of being good as a dish, especially when bred in clear waters and nourished upon a fish diet. It is easily recognised, even in the water, by its broad black bands on the sides, the bright red of its fins, and the big dorsal fin with its sharp spikes. Perch are often said to be excluded from the diet of Pike, on account of the danger of the dorsal spines; but this is a mis-statement, for Pike prey upon Perch, large and small, and even prefer them to other fish.

The Perch loves weedy corners, banks of clay, the neighbourhood of old piles and stumps, the roots of willows below the water, and beds of water-lilies. They are not altogether averse to saltish water, and they thrive in lakes and ponds as well as in rivers. In the Thames these fish are becoming scarcer, and two causes are given for their decrease. The first is the wastage of spawn through the washing of steam and electric launches. Perch deposit the ova on the roots of trees and upon reeds, and the violent agitation of the water by the screws of motor boats washes the spawn away and destroys it. The other factor in lessening the numbers of Thames Perch is the increase of swans and various water birds that devour the eggs. Fortunately, the owners of the swans have now consented to restrain them during the Perch breeding season, and it is hoped that

A PERCH POND.

the stock of these fish will increase in a few years.

Unlike the Pike, the habits of Perch are gregarious. They swim in shoals, the bigger fish keeping company with Perch of about a similar size. Now and again, I have chanced upon a company of large Perch while fishing in rivers and lakes, and the sport has been fast and furious. But in some big rivers it is not always easy to locate the fish, and the angler has often to roam far before he comes upon a shoal. On the other hand, there are waters wherein Perch swarm, where they may be captured almost anywhere, though in such cases the fish are generally small.

A HAUNT OF PERCH.

Perch are fairly distributed throughout our islands. They inhabit waters in the North of Scotland, and many rivers and meres in England, and they are found in some of the Welsh lakes among the mountains, such as Llyn Arenig, many hundred feet above the level of the sea. Perch grow to a fair size in the Loddon—a Thames tributary; in the Wey, the Lea, some of the Sussex streams, and in the rivers and broads of Eastern England some heavy examples have been caught. Mr. F. G. Aflalo mentions seven to eight pounds as a maximum weight for Perch, but a specimen of over three pounds is considered a very good fish. Five pounds is stated to be the record weight of the Perch of Bala Lake, and from Norfolk waters fish of this species have been secured up to four and a half pounds. Jesse states that a Perch of five pounds ten ounces was caught in the Colne. On the authority of Thomas Pennant, whose "British Zoology" was completed in 1770, a Perch of nine pounds has been taken from the Serpentine in Hyde Park.

I have caught Perch of two and a half and three pounds from a private lake, and specimens of about two ounces from the Chelmer, and an overstocked pond in South Wales, where the fish literally swarmed. This difference in weight is to be explained by the liberal food supply in the lake, and the fact that the numbers of Perch were kept down by Pike; whereas in the Chelmer and in the pond in Wales, the Perch were poorly fed, and but little exposed to the depredations of Pike and other enemies.

Perch like a sandy bottom, and in the Norfolk rivers they are found in shoals wherever the sluggish stream flows over a bed of sand. They are equally fond of weedy waters, but do not, as a rule, con-

gregate in swift-flowing currents. The mouths of dykes are favourite haunts, and in lakes that contain trout one may see the Perch waiting in companies for the small trout fry, as they leave the hatching places and venture into the lake.

The larvæ of insects, fresh-water shrimps, shellfish, and earthworms are the food of Perch, and they feed freely upon minnows, young gudgeon, and the fry of several fish. It is an interesting instance of the fierce struggle for existence below the water, when a big Perch, with his back fin erect, and the bronze and green of his scales glowing, dashes into a shoal of minnows in the shallow water, driving the frightened fish in all directions, and causing them to leap in the air to escape the open jaws. A Perch of a pound in weight will seize a gudgeon of four to five inches in length. They often take an angler's spoon-bait when he is spinning for Pike. In some ponds Perch will dart at an artificial fly, sunk and jerked through the water, doubtless mistaking it for a small fish or an aquatic insect. They may be attracted to the fishing ground by worms thrown in over-night, and by stirring up the mud and gravel with a rake at the time of angling for them.

Perch are bolder than most fresh-water fish. Where they abound, it is not difficult to see them, unless the water be discoloured, and by approaching the riverside quietly a glimpse may often be caught of a large Perch or two, or a shoal of small ones, swimming sedately on the fringe of the weeds. In navigable rivers and canals they may be detected close to lock gates and the boardings, or "camp-sheddings" of weirs, while in ponds, on a bright day, their black bands and red fins are frequently visible amid the stems of water-lilies. The temerity of the Perch makes it a favourite among juvenile anglers. Perch are not easily scared, like roach, by coarse tackle, nevertheless, fine methods must be employed for the capture of the Perch of over-fished rivers like the Thames and Lea. Hungry, undersized Perch in quiet ponds and crowded, undisturbed streams take a bait with fierce avidity, and may be pulled out by the score. Bigger Perch are naturally more suspicious, yet there are occasions when they feed recklessly for a spell, and then suddenly grow alarmed and swim away.

William Harrison, in "Holinshed's Chronicles," refers to Perch as protected fish during the Elizabethan period, stating that these, among other fresh-water fish, were preserved during the spawning season "by very sharp laws, not only in our rivers, but also in plashes or lakes and ponds, which otherwise would bring small profit to the owners."

There are old stories of the medicinal value of a stone said to exist in the brain of Perch, and there is no doubt that our ancestors believed in the curative value of the flesh of Perch, which was recommended by physicians to wounded patients and persons in fevers. In ancient Germany, the Perch of the Rhine were esteemed as remarkably wholesome.

By our present fishery laws Perch are protected from March 15th to June 15th. They spawn from April till the end of May, and are not in good condition until August. George Rooper, author of "Thames and Tweed," states that nearly all the Perch he has caught and examined were females, and that at all seasons of the year he has found the spawn fully developed. This is a matter which seems to have escaped the attention of naturalists, and the discovery may help to explain the reduction in the numbers of Thames Perch; for if the majority of Perch taken from the river are females, the balance of the sexes is probably seriously disturbed.

WALTER M. GALLICHAN.

SOME OF THE CASES MADE BY CADDIS-WORMS.
(Natural size.)

STONE-TURNING—II

By R. A. STAIG

Illustrated from Original Photographs by JOHN A. BALLANTYNE

CADDIS-WORMS.
(Natural size.)

MAY is a good month for stone-turning in the shallows of our streams and hill burns; but almost any day from early spring to late summer numbers of aquatic larvæ and other forms of animal life may be found concealed beneath the submersed stones, and upon the under surfaces. The latter is a favourite situation with certain Caddis-worms. These are the larval stages of Caddis-flies, a family of small insects with robust chocolate-coloured bodies and four brown delicately fringed wings more or less ovate in shape. They are often mistaken for moths.

The Caddis-worm, when it comes out of the egg, sets to work to make a protective case within which it lives. It uses various materials for this purpose: sand, tiny pebbles, chips of wood, nibblings of leaves, bits of grass, and even minute snail shells, with their owners inside, whether they like it or not. The skill shown in the construction of some of these

A CADDIS-CASE MADE FROM BITS OF WOOD; AND TWO CASES SHOWING THE ENTRANCES.
(Natural size.)

Caddis dwellings is remarkable. Whatever shape or appearance the structure may have outside, it is invariably tubular inside and comfortably lined with silk; and, though usually just wide enough to admit the creature's body, many are made sufficiently roomy so that our caterpillar-like friend, when he gets tired of looking out at one end of his tube, may turn about and have a look out at the other.

The photograph on page 571 of a group of Caddis-cases found fastened at their ends to the under-side of a stone in a rapid running stream shows very clearly a few of the varied formations of these objects. The four smallest have been made from bits of rushes cut in exact but gradually diminishing sizes, and glued together in fours so as to produce a rectangular and tapering effect. A crude construction is the isolated example above the set of five, which have been built with minute stones of approximate size. More elegant are the horn-shaped forms composed of particles of sand and grit, so equal in size and so neatly cemented together that it is difficult to believe these to be the workmanship of mere grubs.

Many Caddis-worms do not moor their cases to stones but carry these temporary habitations about with them; and we frequently notice a very regularly built case with a small stone or a seemingly superfluous length of stick attached to one end. The small stone counteracts the buoyancy of a light case, and the long stick lessens the difficulties of a fat Caddis walking under water with a heavy one.

Looking again at the horn-shaped cases, we see that three of them have their entrances closed. When the Caddis-worm is about to change into a nymph it spins a web across each end of the tube, and certain species add a stone. In the photograph a case is shown with the side removed, thus exposing the nymph or pupa enveloped in an oval covering.

Very likely the next stone we turn over

"CREEPERS" ON THE UNDER SURFACE OF A WET STONE; AND A MAY-FLY LARVA.
(Natural size.)

has a "creeper" or two upon it, and several Ephemerid or May-fly larvæ. The stout "creepers" are, as a rule, less than an inch in length and readily detected while trying to waggle quickly out of sight; but we may have to look two or three times for the Ephemerid larvæ, as they often remain squat and still; and so perfectly do their colours blend with the green and brown hues of the wet stone, that one is apt, at a first glance, to pass them over unnoticed.

FRESH-WATER LEECHES.
One turned upon its back to show the suckers.
(Natural size.)

The body of the "creeper" is divided up like that of a Centipede; but the head is big and flat, and almost as broad as the first three body segments, which have flat horny shields like half moons, and which are very much wider than the others behind. The eyes are prominent, and the head has two long sensory feelers. A similar pair of thread-like tactile processes project from the end of the body.

The "creeper" swims well; its three pairs of legs are noticeably fringed with swimming hairs. Put a "creeper" into water and you will see little bunches of fine filaments on the sides of its body. The Caddis-worm and the May-fly larva have, in the same position, somewhat similar structures. Breathing organs these are, connected to the air-tubes which ramify throughout every part of the body, conveying fresh oxygen to the tissues and taking away the impure gases.

FRESH-WATER SHRIMPS.
(Natural size.)

All insects breathe by air-tubes, or tracheæ, as they are technically termed; but in the terrestrial forms the air-tubes are in direct communication with the outside air through little openings at the sides of the body. The contained air gives these fine, thread-like, respiratory tubes a beautiful silvery appearance.

Perla, the Stone-fly, which the "creeper" ultimately becomes, does not differ greatly in appearance from the Caddis insect except that it is larger, and closes its wings flat upon the back when about to rest, whereas the Caddis-fly holds them pressed against its sides.

VARIOUS FORMS OF SPONGE SPICULES.
(Magnified forty diameters.)

It is a queer trout that will not rise to a "creeper."

And what is the tough, oval, fleshy thing still sticking to the wet stone? A fresh-water Leech. Such an odd way it moves, fixing first one end, and then looping itself up to fasten the other end close behind where it fixed the first one. It stretches out like a worm, which indeed it is, a kind with two suckers, one at either end of the body.

A closer inspection of the wet surface of the stone reveals a number of tiny objects, like very young caterpillars, sliding along and bending their bodies into so many letters U. They are the larval stages of a common midge. Unless it be the small amphibious (Limnæa) Snail, which we see in clusters upon almost every stone, there is no more familiar denizen of our running waters than the little fresh-water shrimp, Gammarus; the creature with the compressed, cres-

centic body and the sidling gait, a scavenger of the stream.

But the shore is the El Dorado of the stone-turning enthusiast. There are few

THE HETERONEREIS FORM OF NEREIS.
(Magnified five diameters.)

localities which afford such a wealth of varied life.

Any casual observer who happened to find a spread of sponge coating the under side of a weed-clustered rock at low-water mark would probably at once suppose the pulpy, greenish-grey mass to be some sort of vegetable growth. There is certainly nothing about its external appearance suggestive of an animal nature. It is a highly irregular growth

PORCELLANA CRABS AND A MASKED CRAB (PISA).
(About half the natural size.)

full of minute pores, and with raised portions here and there like volcano craters in miniature. If, however, a section through it be examined under the microscope one is surprised to find that what we call the Crumb-of-Bread sponge, *Halichondria*, is in reality a city of waterways, the inhabitants all living very close together. These most minute beings are simple specks of living matter with controlling centres. Those that live along the margins of the waterways have fine hairs, or flagella, which they constantly wave to and fro to keep up the water currents, and thus ensure proper aeration and regular supplies of food. The business of others is to flow out their bodily substance in long "arms," and enclasp passing food particles for the support of the colony; and some manufacture wonderful little needles or spicules of silica for strengthening the walls of their city. The Sponge colony shows us not only division of labour, but also how the higher many-celled animals came to be evolved.

CAPRELLA, THE "NOBODY" CRAB.
(Magnified twelve diameters.)

Various species of a common genus of marine worms, known as Nereis, are abundant under stones in sand and mud between tide-marks. They are usually dark green in colour, and their bodies are much segmented. The photograph shows one which leads a double life, appearing in two distinct phases during the course of its existence; first as a Nereis and latterly as a Heteronereis, with one half of the body completely changed.

A small reddish crab, not generally known, but common enough in the crannies and crevices among stones, especially in mud, is *Porcellana platycheles*. His back is flat and so are his large

densely fringed claws, which, when folded inwards, fit neatly into the margin of his shell. His larger sized relative, the Common Shore Crab, sometimes provides us with an interesting case of degeneration. It is nothing unusual to find one of these crabs with a prominent rounded growth rooted under the body. This is actually a parasitic relation, called Sacculina, who began life as a free-swimming and promiseful larva, but who ultimately settled upon the hapless crab, first within its body and finally beneath its tail, to lead a life of ease, without eyes, without limbs, and without "nerves," but with a capacity for absorbing nourishment at the expense of its host.

Certain kinds of crabs dress themselves up for protection. A perfect example of this is Pisa, the masked crab shown in the photograph. It has a zoophyte growing out over its snout and a living compound of tunicates spread upon its back, besides a thin coating of sponge around its thighs, and sundry objects on other parts of its body. These are actually planted by the crab itself, which has hooked hairs all over its shell for holding securely the various articles of clothing, animate and inanimate.

If we look carefully among the finer seaweeds under the stones in the rock-pools we may come across that grotesque creation, the "No-body" Crab, Caprella, clinging to the weed with its small legs, and swinging about its thin body and large arm claws mesmeric fashion.

At the shore or in the country, whether it be in water or out of it, almost any stone we choose to turn over will provide us with some natural object worthy of our attention, something worth carrying home to have a better look at, no matter how small or insignificant it may seem.

R. A. STAIG.

THE HILL GRASSES

By MAUD U. CLARKE

With Photographs by HENRY IRVING

IN regions as remote from each other as are the high lands from the marshy flats, we find the grass making proportionate modifications of form.

Every sappy particle, expressive of a plant that absorbs abundant moisture, is dried and shrunk into contracted fibre, and consequently contracted bulk of form, in the grass of the high land. The sum total of the plant's days is spent in ceaseless rush of wind and beneath unsheltered glare of light and heat. There must be an equally unceasing effort to maintain the supply for so great a toll on the part of the grass. In every fine, sharply pointed blade of the hill grasses, there is the expression of tense energy, in strong contrast to the loose lush fibre of the water grasses. Millions of rounded blades have been fashioned as bayonets by sheer response of effort to meet necessity.

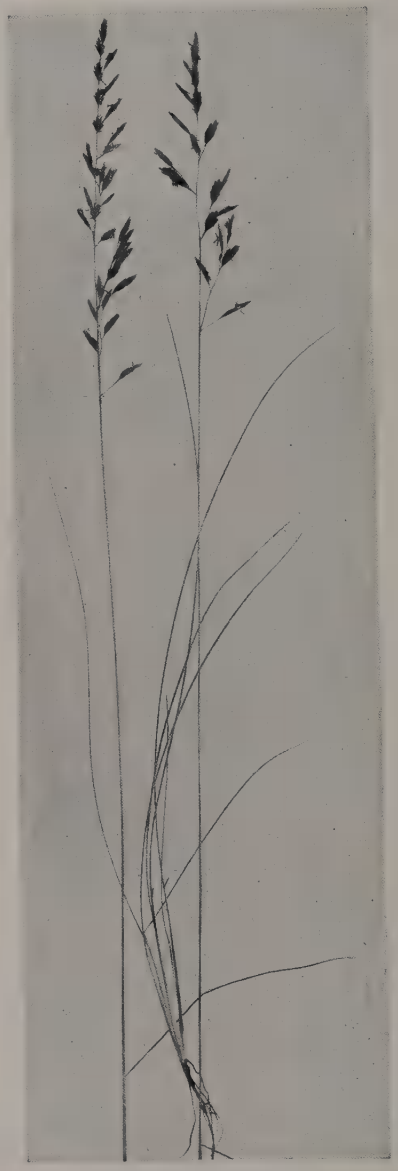
Apart from the moisture kept to a certain extent existent at the roots by the very density of the blades themselves —assisted by the valuable peaty accumulation that grass constructs just above the roots—there is no assistance given by other growths to maintain a moist temperature.

For miles and miles our downlands are devoid of any shelter of tree or shrub, and the grass that lives there meets a stern schooling when one considers that vegetation, in original principle, demanded two things for its well-being—heat and moisture. Turning for a moment from our downland to the tropical vegetation, we see it as an amazing giant, adding complexity to complexity, and growth to growth; the enormous life-forces

welling up in magnificent freedom unhampered of necessity.

But when we consider the hill grasses of Britain we face a wholly different order of things, yet one that is as certainly an expression of life-force which, if less ample, is surely more intense. If less superabundant, it is more vital through conflict. The actual quality of the hill grass is that of very closely compacted cells effecting a fine presentation of the grass-scheme of stem and blade.

MAT GRASS.



SHEEP'S FESCUE.

The broad, sedgy leaf is reduced to a minimum; the flat surface contracted to a rounded one, with its point sharpened to that of a strong bristle.

The initial characteristic of hill grass is that of fine, tough strength, and a densely

CRESTED HAIR GRASS.

tufting habit of growth, as if the life-force were expanded in adding density of compacted blades rather than the liberal expansion of individual ones.

MOUNTAIN CATS-TAIL.

is a common heath grass, the spikelets showing a reddish or purple colour, and standing rather far apart in the notches of the stem. The upper, and lowest blades that fall at right angles across the picture, distinctly show a twisting of the blades upon themselves. To be dogmatic on any such subtleties of growth in plants would be rash, but I would venture to suggest that this twisting may be caused by the unequal play of circumstances; the variations of wind-rush, and consequently of temperature, upon the extending purpose of the blade. In other words, it is one more brand mark of the plant's surrender to check, yet eventual return to its original expression or purpose.

ALPINE MEADOW GRASS.

In both the two first illustrations we find good examples of this principle of being, that of the Mat Grass (*Nardus stricta*), and the Sheep's Fescue (*Festuca ovina*). The flowering heads of the former grass are, however, shown at almost too early a stage to be easily recognisable; the glumes lying very flatly upon the upper portion of the three stems. The formation of the flower-scheme in this species differs from that of those previously treated, since there are no empty glumes in the spikelets; they are absent, leaving only the true flowering glume, which is shortly awned, bearing the stamens and a one-styled carpel. It

The portion of the rootstock, showing at the base of the left-hand flowering stem, illustrates the strong tuft-

ing nature of this grass. Securely enveloped in the sheathing membrane, immature blades of several lengths are shown packed one upon the other. They are glabrous in type, that is, non-hairy, and purely green in colour.

In contradistinction, the Sheep's Fescue is glaucous, having a grey bloom on blades that are almost cylindrical in form. It is also a strongly tufting grass, varying from an inch or two to twenty-four; the flower stem is a four-angled construction supporting a purple panicle of perhaps four inches in length. The spikelets are small, and the glumes show little, if any, of the hair-like awns.

It is one of our commonest grasses on the dry uplands, and, like the Mat Grass, is perennial in root-stock, flowering through June and July. Compared with the finely attenuated blades, the flowering head is a strong construction showing some breadth of development.

Kœleria cristata, the Crested Hair Grass, although a grass of short growth associated with high dry pastures, is far less typical than those species already mentioned. For the surface is downy, although the flowering glumes are membranous, green and white in colouring, and have a silvery sheen upon them. The shortened growth of twelve inches proclaims the grass of dry quarters, yet the stout stem and solid nodes, together with the broadened blade, expresses relationship with the grass of the valleys. The spike may vary from one inch to four inches; when meeting the diminutive example we more easily recognise the plant contracted by its situation, and forming the distinct species.

DOWNY OAT.

A still stronger departure from the contracted type of hill grass is the Mountain Cats-tail (*Phleum alpinum*). It is an admirable instance of Nature's apparent extreme objection to be regulated, even by principles of growth, according to circumstance. Exactly when you have made elaborate definitions and classifications concerning species, and founded general rules concerning them—as taught by themselves, moreover—just then an individual, or a species, wriggles from precise grasp and escapes by the back door, to be and grow as it likes, and where it likes. And our part is then to observe these facts, and reflect upon them, always recollecting that Nature is both extremely flexible and extremely self-willed—for all said and done, the acceptance of modification is only the determination to persist turned inside out.

The Mountain Cats-tail, living high up in the world, in stature anything from six inches to eighteen, is, after all, our old friend the Timothy Grass of the meadows.

Although botanically classed as a separate species, one must not forget that this is an entirely fictitious arrangement of man's making, and inherently none of the plant's own. For we see in this mountain variety the same inflated leaf-sheath and broad blade that possess a certain resemblance to the Reed. Indeed, the term *Phleum*, coming from the Greek word *phleos*, a reed-like plant, is very suggestive that apart from our own shores this grass may be very much more reed-like.

There is little of the attenuated character about it, although there is reduction in actual height. Sometimes, this species is the water-loving one, even at a high altitude, as it is found on the edges of mountain springs. The purple spike,

of an inch long, has the glumes awned, forming something of a bristly head. It is a perennial plant, but flowers, however, only in July.

In a previous article on the Hayfield Grasses, mention was made of *Poa Annua*, the Annual Meadow Grass, there was, however, no illustration of it. Of the same family, but distinct in appearance, is the Alpine Meadow Grass, *Poa Alpina*. It is a tufted species found in high mountain districts, and has rather short, broad leaves, bluntly tipped. The stem growth is somewhat bent at the base —an emergence from the creeping habit of growth towards the vertical, and common to many varieties—with a leaf-sheath swollen at the juncture with the root. In *Poa Annua* we are familiar with the obviously triangular shape of the flower panicle, a three-inch of height equalled by its breadth, the glumes a clear bright green. But in *Poa Alpina*, a perennial species, there is a departure in form to a more elongated panicle, which branches into pairs of spikelets from the stem. In the right-hand stem of the illustration, that is shortened above the node, the rounded character of the blade is well shown, how the edges re-curve upon itself the whole length from the juncture with the ligule to the blunted tip. In the central example of the group the tufted growth is also exhibited, a series of blades springing out all round the lower portion of the most interior blade during its upward growth.

The Downy Oat belongs to the high, chalky land, although it attains two feet of growth. *Avena pubescens* at once reminds us of the Common False Oat, previously mentioned, although the latter is botanically removed from the family of *Avena*, save in the sub-title of *Avenaceum*. Comparing the two, we notice that the flowering spike is more contracted, a simpler arrangement, save in the lower group of branchlets, as illustrated in the right-hand specimen of the two; much of the upper length expresses the glumes almost without branches at all.

The radical leaves are distinctly downy, whilst the ligule is sharply pointed; this is well shown on the extreme right-hand stem of the group. The bent, twisted awn is characteristic of both these varieties.

In the illustration on the left hand of the group, we clearly see the working principle of the grass-anatomy, as one may term it—that of the outward extension from within of layers, or *laminæ* of blades, superimposed upon each other. There are two sheathing layers overlying the third inner layer, or separated blade, which finally escapes into freedom as the others themselves bend outwards into freedom, afterwards aspiring to considerable height. This elaboration of layers seems to be the method of expression of the grasses' green life-spring of force always welling up from the rootstock.

In the smallest of starved grasses there is the infinite mystery of capacity for projecting one series of cells into the form of radical blades, and another into that of the complex flowering stem and all its sections; for there is no true apprehension of the matter, and the word mystery, or miracle, only is appropriate.

MAUD U. CLARKE.

HOW TO KNOW THE REPTILES

By DOUGLAS ENGLISH, B.A., F.R.P.S.
Author of "Wee Tim'rous Beasties," "Beasties Courageous," etc.

THE GRASS SNAKE THE SMOOTH SNAKE

With Photographs by the Author

THE Grass Snake is practically unknown in Scotland. In point of distribution, therefore, the Adder must be considered the commonest serpent in Great Britain. In southern

THE GRASS SNAKE.

counties, where both Adder and Grass Snake are plentiful, I am inclined to think that the latter is actually the most numerous. He is certainly the most obvious, but this may be due to his inclination to bolt when alarmed, whereas the Adder lies low to the last, and, for this reason, must often escape notice.

As we get northward the Grass Snake tends steadily to become scarcer, and there can be little doubt that this scarcity is due to the low autumnal temperatures of the northern counties. Unlike the Adder and the rare Smooth Snake, which produce their young in membranous envelopes which rupture at birth, the Grass Snake lays eggs which require a considerable degree of heat for incubation, and which hatch somewhat late in the year. These eggs are usually deposited in some heap of decaying organic matter in which heat is spontaneously generated—a dung-hill, for example, or a pile of weeds; and the fact that such heaps are usually artificial accounts for the persistence with which Grass Snakes frequent the immediate neighbourhood of human habitations. They will visit the same manure heap summer after summer, and the "turning" of it in the autumn will often bring clutch after clutch of eggs to light. A single snake probably lays three or four clutches, each of which contains about forty eggs, glued to one another by a sticky secretion, elastic to the touch when fertile, and, when about to hatch, some twenty-five millimetres long. The "shell" is a whitish membrane of the consistency of stout paper, and the young snake cuts through this by the use of a temporary horny tooth projecting from the snout.

An old female Grass Snake attains to quite formidable dimensions. I am not certain that any record of a five-foot Grass Snake in this country is indis-

putable—a three-footer is a fine specimen—but there are plenty of certain records of Grass Snakes approaching four feet in length, and I have myself handled an amiable female of forty-four inches.

The superiority in size of the mature female over the mature male is marked, though, as is often the case with reptiles, it is the male who has the longer and more tapering tail. I remember once encountering, on the bank of a stream, what I took to be a female of a size to beat all records, and being disappointed to find that what I had imagined was her tail was, in reality, a complete suitor barely half her length.

Both our harmless snakes belong to a very large family, the *Colubridæ*, which has been arranged by Mr. Boulenger into three groups, according to the presence (or absence) and the position in the upper jaw of *grooved* teeth. The first group, the members of which have solid, grooveless teeth, embraces the sub-family of Colubrines, to which most of the snakes kept as pets by the ophiolatrous belong. All these are perfectly harmless, in the sense that they are not venomous; but many of them bite with a will, and the bite of a large specimen is, of course, to be avoided. The second group contains snakes which have one or more teeth in the back part of the upper jaw grooved. Some of these are venomous, but none is so deadly as the members of the third

1. THE GRASS SNAKE. 2. THE SMOOTH SNAKE.

In these pictures the resemblance between the head scales should be noticed. The Smooth Snake is in the act of sloughing, and the eye-scale has already loosened, giving the eye an opaque appearance.

group, such as the Hamadryad ("King of the Cobras"), the ordinary Cobra, and the Black Snake of Australia, which have teeth in the front part of the upper jaw grooved or perforated. The venom of the Cobra is considered to be sixteen times as powerful as that of the Adder, and it has been estimated that ·015 of a gramme of its venom will kill a human being.

EGGS OF THE GRASS SNAKE.

More than a thousand species of Colubrine snakes have been distinguished.

They have, as might be expected from their multitude, a world-wide distribution (the only impassable barrier to snakes on a continent is the line of permanently frozen ground), and they include aquatic, semi-aquatic, arboreal and terrestrial species. Our own Grass Snake may be reckoned as semi-aquatic. He is, at the same time, an excellent climber. His slough is usually found a foot or so above ground level, and he runs the hedgerow in search of eggs and nestlings. Where both he and the Adder are found in the same county, it is the Grass Snake who prefers the low-lying damp situations, while the Adder is more usually in evidence on the dry heights. Where no high ground exists — as in the Fens, or the Essex marshes—the Adder frequents the highest points available—the dyke-banks, for example.

In coloration the Grass Snake may easily be distinguished even from a dingy Adder. The yellow collar round his neck, from which is derived his alternative name of "Ringed" Snake, is a distinctive character, and, so far as British Grass Snakes are concerned, practically invariable. It is thrown into strong relief by the darkening of the scales behind it. In the newly hatched young (I may mention that Grass Snakes' eggs can easily be hatched in a hothouse where the temperature is maintained above 60° F.) the collar is of a blue-grey colour, but in a few days' time it acquires the yellow tint, and is even more conspicuous in a young, round-eyed, large-headed snakeling than in a mature snake. On rare occasions the blue-grey collar persists as a whitish colour in the adult.

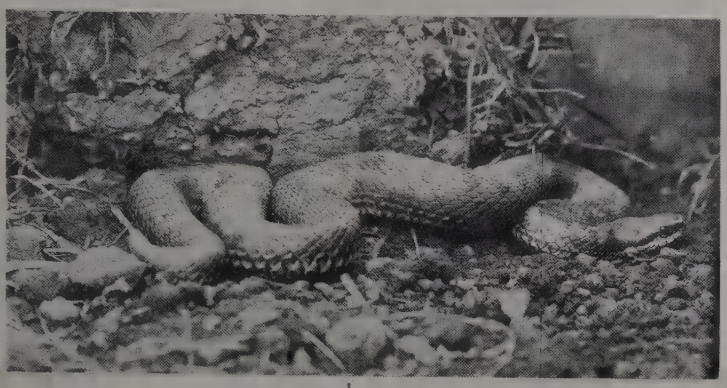
The body-colour of the young may be described as a dark green-olive. In the mature specimen it varies with the age of the skin, and, to some degree, I think, with the locality "Olive" describes it fairly enough, for the variations of tint which it displays correspond pretty closely with the variations in the dinner-table olive.

Along the Grass Snake's sides are irregular black spots, and beneath these are to be found vertical black hatchings.

The scales, compared with those of the Smooth Snake, are keeled, but their "mid-rib" is not so evident as is the case with the Adder.

A Grass Snake's food normally consists of amphibians and fish. Several instances, however, have been recorded of his swallowing mice and small birds, and there is one curious record (*Field Naturalist's Quarterly*, Nov., 1903) of his swallowing a mole.

In swimming the Grass Snake holds his head six to eight inches above water, and proceeds by an eel-like undulation of the trunk and tail. To catch fish, he must, of course, plunge his head below the surface, but he follows the habit of most semi-aquatic creatures in bringing his prey ashore to eat it. This procedure is forced on him. As we have noted in the case of the Adder, a snake swallows by working himself outside his victim rather than by ingurgitation, and, to do this, he must have something solid both to push off from and to push against. The Grass Snake has no teeth to correspond with the poison fangs of the Adder, but is well provided with small teeth, having four rows in both the upper and the under jaws. All these teeth are



1

2

3

THE THREE BRITISH SERPENTS.

1. The Adder. 2. The Grass Snake. 3. The Smooth Snake.

recurved, so that little effort is needed to shift the grip on his victims a tooth or so forward.

In the case of the gorged Adder it is usual to find that a mouse has been swallowed head first, and we may assume, in the absence of any record whatever of a mature Adder feeding naturally in captivity, that a mouse who does not present himself in a convenient "lie," is paralysed and then adjusted to suit the Adder's convenience. It must be remembered in this connection that an Adder's fangs are brittle, and need careful nursing, and that he has no "border" teeth in the upper jaw.

THE RARE BRITISH SMOOTH SNAKE.
The body markings should be compared with those of the Adder, and the heart-shaped V at the back of the head noticed.

As far as captive Grass Snakes are concerned, I have found that a frog or newt is just as likely to be swallowed feet first as head first. This may, in part, be due to the fact that amphibian skulls are easily compressible and amphibian teeth insignificant. Generally the frog is caught by one hind-leg, which is soon joined by its fellow. The whole process is singularly horrible to watch, and I feel I need make no apology for illustrating the last phase only, though I cannot think that the frog is in any way conscious of his predicament. I have already referred to instances of his being disgorged alive and uninjured.

A Grass Snake who is cornered, presents, if he be a sizable snake, a bold front to adversity. He hisses loudly, sometimes opens his mouth, flattens the nape of his neck, emits a singularly noisome smell, and swings himself back or sideways as though about to strike. Sometimes he actually does strike, but it is a lash rather than a lunge. The usual attack of the Python or Boa is a lash of the head and the fore-part of the body, the constricting force being held in reserve, and only employed when a serious meal is contemplated. Our Smooth Snake, who shows fight in much the same way as the Grass Snake (but emits no smell), affords a further resemblance to the older type in his habit of winding a coil of himself round his intended meal, and another coil round some fixed support.

The Smooth Snake is unquestionably scarce in this country, being confined to the heath and pine country in the south. The fact that the Sand Lizard is found in the same localities is fair presumptive evidence that Sand Lizards form part of his normal food, but it is going too far to say that they form the whole of his food. The heath and pine country has a characteristic fauna, and is especially rich in insects. From the success of the Rev. O. Pickard-Cambridge's experiment—he kept a specimen of the Smooth Snake in good order for several months by feeding it on bluebottles—we may assume that the Smooth Snake at large has a catholic taste.

In point of size (eighteen inches to two feet), and in the markings on his skin, the Smooth Snake displays a superficial resemblance to the Adder. Examination of the photographs will show, however, that his build is essentially Colubrine, and that his markings afford a distinct means of recognition.

The "V" at the back of his head is heart-shaped. Behind it come parallel

rows of blotchings which sometimes coalesce into transverse bars, but never form a zigzag.

In a fresh skin the Smooth Snake is a very handsome reptile, his ground colour being steel-grey and his spots a darker shade of the same. It may interest those of my readers who are photographers to know that soft bromide prints from my negatives of the Smooth Snake afford a close approximation to natural colouring. On an old skin the markings are indistinguishable and the general tint is much browner. The head plates of the Smooth Snake, which can be well seen in the photograph on page 581, are proportionately larger than those of the Adder, and are distinguished from them by the fact that the "frontal" in the centre, the "parietals" just behind it, the "nasals" in front of it, and the "supra-oculars" on either side, have their boundaries strictly contiguous. In the Adder these pre-eminent plates are generally separated from each other by smaller ones, so that the total number of plates on the head appears to be much greater than in the Smooth Snake. In the Grass Snake the same head plates are contiguous, but the supra-oculars are proportionately larger, and the nasals proportionately smaller, than the supra-oculars and nasals of the Smooth Snake.

An additional distinction from the Adder is afforded by the shape of the pupil of the eye. In the Adder this is a vertical slit, in the Smooth Snake it is a circle.

A GRASS SNAKE WITH A FROG IN ITS GULLET.

The gullet extends from the ring round the snake's neck to the top of the curve in its body between the two large stones. Its enormous distension can be judged from the fact that the scales on it are separated from one another. One of the frog's fore-legs can be trac d between the snake's jaws.

The credit of first discovering the Smooth Snake in England belongs to Mr. Frederick Bond, who secured a specimen when in company with the Rev. O. Pickard-Cambridge in June, 1853. Since that time the records have been spasmodic in character. In some years the snake appears to have been comparatively common, then a long gap ensues; then it turns up again. A correspondent writing to *Knowledge* (September 4th, 1885) refers to two in his keeping which had been captured in Suffolk. This appears to be the only instance of their occurrence outside the heath-land of Dorsetshire, Berkshire, Hampshire and Surrey.

During Professor Leighton's editorship of the *Field Naturalist's Quarterly*, several captures of the Smooth Snake were communicated to that excellent and unfortunately short-lived journal. These records can hardly be said to have widened his distribution, but they unquestionably established the fact that, if field naturalists knew where to look, and what to look for, their chances of securing a Smooth Snake were by no means so remote as had been generally supposed.

The Smooth Snake ranges over the greater part of temperate Europe. His distribution in this country finds an exact counterpart in Belgium, where he is scarce, and confined to the heath and pine districts; in these districts the Sand Lizard occurs also, and is believed to constitute his staple food. It is of interest to learn that our own Smooth Snake (*Coronella austriaca*), or some closely allied Coronella, is common in the island of Malta. We may reasonably assume that the "viper" mentioned in *Acts* xxviii. 3, 4 was of this species. Both the "fastening on the hand" and the emergence from a "bundle of sticks" would be characteristic, several observers having noted the tendency of the Smooth Snake to cling to anything which it has seized in its mouth, while its protective coloration and prehensile habit would account naturally enough for its being collected unawares in a bundle of firewood. Two words occur in the Greek, the first, *echidna*, being translated "viper," while the second, *therion*, is rendered "venomous beast," "venomous" being an interpolation by the translator. It will probably surprise some proportion of my readers to learn that *therion* is the same word as our "treacle," and that "treacle" is in its origin essentially connected with snakes. For the evolution of the word (the bearing of which on the use of "adder-oil" for snake-bite will be easily recognised) I am greatly indebted to the Rev. T. Wolseley Lewis, who has permitted me to condense a communication which he made on the subject to *The Countryside* of October 26th, 1907. After referring to one of the old English versions of *Jeremiah* viii. 22—"Is there any *treacle* in Gilead?"—Mr. Lewis goes on to explain that the belief that like cures like, and that snake-bite should therefore properly be treated by a decoction of snake, was prevalent in very early times. Galen, the father of Medicine, was well acquainted with this belief, and the name of his system of pharmacy, *Theiraca*, embodies the popular idea. From *theiraca* came, by ordinary phonetic changes, *theriac*, *theiracle*, *triacle* (Chaucer), and *treacle* (Milton). First it meant decoction of snake, then any antidote, then the sweet syrup by which the taste of a nauseous drug was disguised, and, finally, syrup pure. When molasses was first introduced from the West Indies it was found a convenient vehicle for medicine, and so was entitled *treacle*; "golden syrup" is quite a latter-day refinement.

DOUGLAS ENGLISH.

A SMOOTH SNAKE
in an old skin, the markings indistinguishable.

HOW TO KNOW THE TREES GROWING IN BRITAIN

With Notes, descriptive and photographic, for their Identification in all Seasons of the Year

By HENRY IRVING

THE PLUM AND CHERRY GROUP

THIS group, and that of the Apples and Pears which follows, are classed together by botanists as belonging to the order of the Rose. The trees of this order give to our spring-time its character of luxuriant blossoming. What we should miss without their wide-flung masses of white and cream and rose, on hedgerow and by the wayside, over the broad common-land or by the woodland border, not to speak of the acres of bloom concentrated in orchards of Plum and Cherry, Apple and Pear, it were hard to say. The bounty of the autumn, too, is largely of their bestowal, in weighted branches of ranged or clustered fruits, in purple and orange, gold and ruby.

Some characteristics possessed in common by these trees may here be mentioned. Their flowers, separate or clustered, are complete, having both stamens and pistils. Bees, moths, and other insects are the agents for carrying the pollen ; these flowers are therefore made conspicuous by white or tinted petals, and they are rendered especially attractive by their scent, and by their store of nectar. Their seed is produced in the form of a kernel enclosed in a hard, stony shell, or as a "pip" possessing a firm coat and enchambered in a parchment-like walled cell, the stone or pip being embedded in a mass of edible pulp. The fruit, so constituted, is rendered conspicuous, when ripe, by vivid colouring, and is particularly alluring to birds and animals, which are in the main the agents for its distribution.

A useful point of distinction between the two groups indicated above is found in the fact that, with the Plums and Cherries, the fruit is formed within the cup of the flower, above the green calyx, which falls with the petals ; whereas the fruit of the Apple and Pear, and the trees associated with them, is formed at the top of the stalk, beneath the calyx. Here the calyx does not fall, but remains attached, in the form of a dried rosette, at the top of the fruit.

BLACKTHORN LEAVES.

THE BLACKTHORN OR SLOE

This may rank as a small tree, but is usually a bush, and not unfrequently merely a constituent part of the hedgerow. It is most noticeable in early

spring, when its dark twigs seem almost black in contrast with the porcelain whiteness of the flowers. The chilly beauty of these, with no softening background of foliage, seen only against Blackthorn twigs, and at a time when east winds chiefly prevail, seems to lay emphasis on the harshness of this particular time of

BUDS OF BLACKTHORN ON LONG SHOOT AND ON SPURS.

year, known for that reason as "the Blackthorn winter." The late P. G. Hamerton said, "a single Blackthorn can chill the edge of a forest."

The twigs are stiffly branched, and strongly armed with thorns. The buds are arranged spirally on these. They appear often in groups of three. Each little bud is rounded and blunt. The buds are crowded on the short spurs. The leaf-scar is elliptical. The leaves are oval, pointed at the base and at the tip, with their margins evenly and finely toothed. They have a strong midrib, but the six or eight pairs of secondary ribs are weak. The autumn colour of the leaves is yellow to reddish. The flowers grow singly on short stalks, but in close ranks, and appear before the leaves. Looked at closely, each flower is very beautiful, with its pure white petals, upholding, as it were, the central expanding tuft of stamens, each of which is topped as with gold. The fruit is nearly round, like a small black grape, but stand-

LEAVES OF THE BULLACE.

ing single and erect, and covered with a waxy bloom. This bloom is easily rubbed off, and has generally disappeared by the time the fruit is ripe.

THE BULLACE

The Bullace may be regarded as a variety of the Blackthorn. The following points may be noted for comparison.

The twigs are stouter and downy. They have but few thorns. The buds are longer and pointed, downy also. The leaves are somewhat broader, with larger serrations. The larger flowers grow in pairs, and open both before and with the leaves. The fruit is more oval, larger, sometimes yellow in colour. It hangs down from the twig.

THE WILD PLUM

The Wild Plum is probably a mere escape from cultivation. The twigs are greenish to brown, and smooth. There are no thorns. The buds are large and

BLACKTHORN IN BLOOM.

GEAN IN BLOOM.

pointed. The leaves are shorter and broader, and of rougher texture. The flowers are greenish white. They grow in pairs, and appear after the leaves. The fruit is oval in shape, pendent on longer stalk, and approximates to that growing in the orchard.

FOLIAGE AND FLOWER BUD OF GEAN.

THE GEAN, OR COMMON CHERRY

Whether our thoughts run to Cherry blossom, or to "Cherries ripe," there is no question as to our interest in this tree. Mr. Meredith, thinking of the blossom, names the Wild Cherry, "Vestal of the forest."

In winter the tree shows strong, ascending branches, with erect twigs and a considerable number of dwarf shoots crowded with buds.

In spring, leaves and blossoms come out together. Viewed at a distance, the leaves are quite hidden by the flowers, which are of a soft pearly white, and very translucent. Spenser's vision of Hope might well take form here:

"In silken samite she was light arayd,
And her fayre lockes were woven up in gold."

For, looked at closely, the delicate purity of the blossom is sustained by the rich, reddish brown colouring of the young leaves.

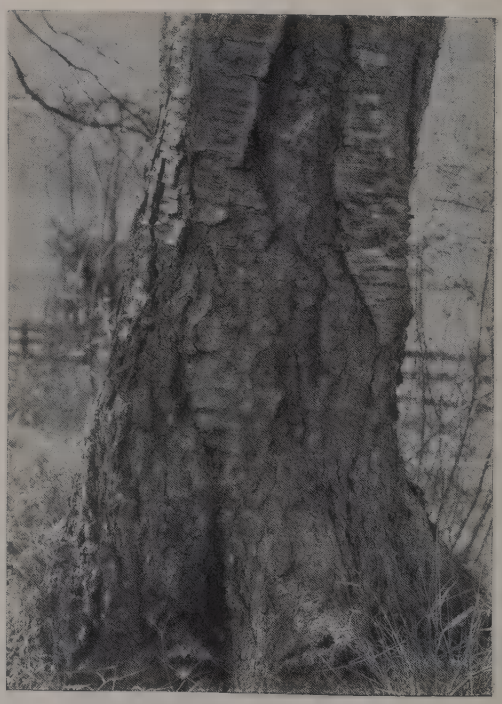
In summer the large pendent leaves, growing often in tufts, and of a fine matt green, make a strong foil for the drooping clusters of red, or red-black, fruit. But the fruit quickly disappears before the eager raids of the blackbirds.

In autumn the leaf tints are striking and varied, making a rich display, with yellow and orange, pink and red, crimson and brown, all harmoniously intermixed

The bark is very distinctive, rough with deeply-cut downward fissures, but also showing satiny patches scored with transverse lines, after the manner of that of the Birch. These patches of bark scale off, curling up at the edges and separating along the transverse lines.

BUD OF GEAN (ENLARGED).

The twigs are erect and stout. The buds are large and pointed. They are brown in colour, and are protected by numerous overlapping scales. They are arranged spirally on the twig and stand upon prominent leaf bases. The flower buds are round; the leaf-scars nearly triangular. The leaves, on long stalks, hang with their points down. The margins are doubly toothed. At the top of the



TRUNK AND BARK OF GEAN.

LEAVES OF GEAN.

leaf-stalk, near its junction with the leaf, are two little red glands. The flowers grow singly, each on a long stalk; a number of these stalks emanate from a single point in the twig, giving to the flowers a bunched appearance. At the base of the flower stalks are a number of membranous bracts. The fruit is heart-shaped.

This tree, like the Birch, is very subject to the diseased growth known as the Witch's Broom.

THE DWARF CHERRY

This is merely a bush or shrub. The following may be noted for comparison. The twigs are slender and drooping. The buds are smaller and blunt. The leaf-scar is half-moon shape. The leaves are not pendent, and have shorter stalks. They are harsher in texture, and their autumn colouring is less varied, being chiefly yellow and red. The flowers have harder petals. At the base of the flower stalks are some small green leaves. The fruit is globular and more juicy.

THE BIRD CHERRY

This is a small tree found chiefly in the north. The twigs are stiff and erect. The buds are large, conical, and sharply pointed. They are pressed up against the twigs, round which their points curl, suggestive of a continuous spiral. The bud scales at the base are brown, those near the tip are yellow. The leaf-scar is oval.

The leaves are broad, elliptic, having a larger side. Their surface is rough. The margins are finely toothed. In autumn the colour changes to greenish yellow and red. The flowers grow in a tasselled spray, after the manner of those of the laburnum, having a central pendent stalk, with numerous branches, to each of which a white blossom is attached. The fruit hangs by the same central stalk, and forms a cluster like a sparse bunch of small black-currants.

HENRY IRVING.

LEAVES OF BIRD CHERRY.

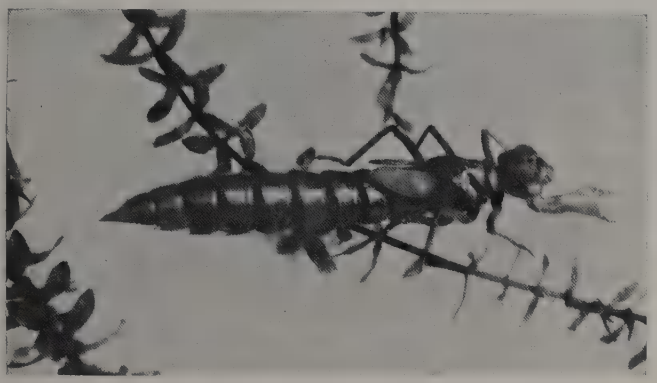
THE HAUNT OF THE DRAGON-FLY.

POND LIFE—I

By F. MARTIN DUNCAN, F.R.P.S.

With Photographs by the Author

DURING a long country ramble, what can be more delightful than to rest for a while beneath some graceful tree that casts its shadow upon the banks of a quiet pool? Ever and anon a gentle wind ripples the mirror-like surface of the water, and faintly sways the slender reeds that clothe the margin of the pool, making murmuring music amongst their stems, that sounds like the soft, sweet song of some graceful, slender-limbed dryad. Gradually the breeze sinks to rest, leaving the surface of the pool like a polished mirror, in which the glorious white clouds, sweeping across the deep blue sky like stately silver galleons, are reflected. Not a ripple dimples the surface, nor breath stirs the reeds; a magic stillness broods over all. so that indeed we rest beside a silent pool, a pool that "holds as 'twere the mirror up to Nature." Even the Dragon-flies have for a brief space ceased their swift, darting flight, and rest upon an overhanging spray of foliage, their gauzy wings scintillating rainbow hues in the sunlight, their slender bodies gleaming



NYMPH OF DRAGON-FLY.

like polished turquoise. How vividly they recall Tennyson's exquisite description of their final transformation:

"To-day I saw the dragon-fly
Come from the wells where he did lie.
An inner impulse rent the veil
Of his old husk: from head to tail
Came out clear plates of sapphire mail.

* * * * *

He dried his wings: like gauze they grew;
Thro' crofts and pastures wet with dew
A living flash of light he flew."

Beautiful as is the surface of the pool, could we but plunge beneath its waters, and as we slowly sink towards the bottom, diminish in size and at the same time increase the magnifying powers of our eyes, we should indeed enter a romantic and magical world. A world peopled with the strangest forms of life, creatures at once graceful, hideous, beautiful, bizarre. Here, attached to the stem of a water weed, is a slender little tower crowned by what looks like a beautiful silver pansy, around the petals of which there is a delicate chain of hairs in constant movement. A gigantic beetle flashes past, and the silver pansy instantly disappears within the miniature tower out of harm's way. Strange-looking creatures, with cigar-shaped bodies and long, slender legs, crawl stealthily over the floor of the pond, amongst the brown leaves and mud. Indeed it is a veritable fairyland, this world beneath the surface of our quiet pools, full of the most wonderful and varied collection of creatures and plants.

Let us examine more closely these strange cigar-shaped creatures, and see what we can find out about their life-history. They are the larvæ of the Dragon-fly, and for all their sluggish movements are amongst the most blood-thirsty denizens of the pond. Though at the first glance they look comparatively harmless, defenceless creatures, closer inspection reveals the fact that they are armed with a powerful and most extraordinary weapon of offence and defence, in their lower "lip." This remarkable organ is very long, and furnished with a pair of most formidable pincers or palps. The "lip" is attached by a kind of hinge to the chin of the insect, which is also fairly long, and the whole weapon, when not in use, rests against the under part of the body. When seeking its prey, the Dragon-fly larva remains quite motionless, or only moves very, very slowly and cautiously along, so as not to attract undue attention. Presently a small insect passes by at what looks like a safe distance,

THE DYTISCUS BEETLE
is a terror to the weaker inhabitants of the pond

but the unfortunate creature has not calculated that a telescopic weapon is carried by the foe, and in an instant the larva shoots out its pincer-armed lip, and grasps its unsuspecting victim. The Dragon-fly larvæ are most voracious creatures, and not only are they a terror to all the lesser fry of their aqueous world,

A DIFFERENCE OF OPINION LEADS TO—

but they are sorry cannibals. They can get out of the way of their own enemies with quite astonishing rapidity, considering the slow and deliberate manner in which they move about under ordinary conditions. When alarmed they expel the water in their intestine suddenly and with considerable force, which has the effect of projecing them at a rapid rate to a safe distance.

The Dragon-fly undergoes what is termed incomplete metamorphoses; that is to say, the larva does not change to a quiescent chrysalis as does the larva of a butterfly or a beetle, but gradually changes to what is called a "nymph," though anything more un-nymphlike in appearance it would be difficult to imagine. It was, indeed, a sorry and sardonic piece of humour on the part of the worthy man of science who gave these ungraceful, bloodthirsty creatures the beautiful old Greek name *nymph*, for they are singularly unlovely. They resemble the larvæ in general habit and appearance, save that the body is longer, and has upon the back the rudiments of wings. When it is ready to undergo its final transformation, the "nymph" crawls up the stem of a reed, and, resting in the sunshine, allows its body to dry. The skin then splits, and the perfect Dragon-fly emerges. For a while it rests upon the empty nymph-case, to permit its body-plates to harden, and the gauzy wings to expand and dry, and then it flits away like a living flash of light.

Another terror to the inhabitants of the pond is the Water Beetle (*Dytiscus marginalis*), which in both the larva and adult stages of its existence is carnivorous in its habits, and attacks all kinds of aquatic insects, small fish, newts, and tadpoles. The larvæ have cylindrical shaped, tapering bodies, with fairly long legs. Their head is large and broad, and their powerful jaws, or mandibles, are arched, and perforated at the tips,

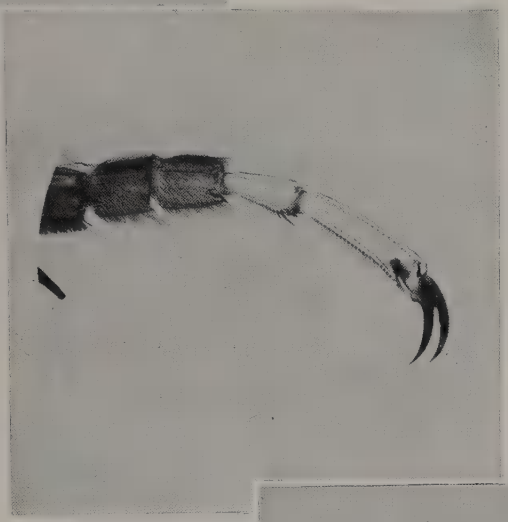
A BATTLE ROYAL (DYTISCUS LARVÆ).

so that they can suck the blood of their victims. These Dytiscus larvæ, besides being armed with powerful jaws, have very thick and tough skins, so that they have comparatively little to fear from foes of their own size. They are very pugnacious creatures, and are given to fighting amongst themselves, and if kept in an aquarium deadly combats may be witnessed, the vanquished becoming a banquet for the victor. When ready to change to the pupa stage of its existence, the larva quits the water, and excavates for itself a little cave or chamber in the earth on the bank of the pond, and within this safe retreat casts its skin and becomes a dormant pupa.

In due course, the Dytiscus beetle emerges from the cave in which it has passed through its final transformation, and plunges beneath the surface of the pond. Clad from head to foot in hard, horny armour, and with the mouth parts developed into powerful biting organs, Dytiscus is more than a match for any inhabitant of the pond, save a full grown pike, or a duck, and accordingly he leads

FRONT LEG OF MALE DYTISCUS BEETLE.
Showing the curious suckers.

an arrogant and somewhat sanguinary existence. Even his courtship is carried out in a pugnacious manner, and the males fight fiercely for the possession of the females, whom they treat with but scant courtesy. The three pairs of legs of the male Dytiscus are very remarkable, each pair being adapted to a special purpose. The first pair bear, near what may be termed the wrist, a disc covered with curious suckers, which enable the beetle to obtain a close grasp of any object, and are also used to embrace firmly his coy and slippery lady-love. The second pair are long, and terminate in powerful hook-like claws, admirably adapted for climbing up the weeds and banks of the pond; while the third or hind pair of legs slightly taper towards the foot, and are fringed with stout hairs, making ideal paddles with which Dytiscus propels himself through the water.



THE SECOND LEG (MIDDLE PAIR) OF DYTISCUS.
Used for climbing.

At frequent intervals these beetles rise to the surface of the pond, and thrust out the end of their body to take in a fresh supply of air, through the spiracles or breathing pores, which lie just under the wing cases along the sides of the body. During the summer, should food grow scarce, or the pond show signs of drying up, the Dytiscus will crawl up the reeds, or on to the bank, and spreading its large and powerful wings, fly off in search of more congenial quarters. This migration of the Dytiscus beetle from one pond to another has been attended by some very curious and interesting results, for it has undoubtedly helped to spread the now almost universal growth of the Canadian pondweed in our ponds, lakes, and slow, shallow streams. The story of the introduction of this prolific weed into England is rather interesting. Some living specimens were sent over to the

HIND LEG OF DYTISCUS.
Used in swimming.

botanical laboratory of one of our universities some years ago, and ultimately escaped into the river. It is a plant that makes very rapid growth under suitable conditions, by throwing out young shoots and roots from the main stem, so that a small piece thrown into a pond soon establishes itself and becomes a dense tangled growth. Moorhens, wild duck, and geese, as well as the Dytiscus beetles, get their legs entangled in the weeds, with the result that small pieces of the brittle stem are detached and carried away to the next pond or stream, as the case may be; and in this way the plant has spread to nearly every pond and stream in England.

THE SPIRACLES THROUGH WHICH THE DYTISCUS TAKES IN ITS SUPPLY OF AIR.

Dytiscus has several interesting though smaller relations, denizens of the pond, who are more oval in shape, and, although of lesser size, equally rapacious.

A curious and interesting beetle is the Whirligig, which has gained its popular name from the quaint, rapid, gyrating movements it performs upon the surface of the pond. The position of the eyes at the side of the head of this beetle is so arranged that it may practically be said to have four, the lower pair looking down into the water, while the upper look upwards. The result is that while with the lower pair of eyes the Whirligig watches for its prey or for the approach of an aquatic foe, it can at the same time keep a sharp look-out with the upper pair for any feathered foe that might swoop down from above. The larvæ of the Whirligig are very quaint-looking creatures; they somewhat resemble small centipedes, owing to the body segments being furnished on each side with slender, leg-like processes, some of which undoubtedly serve as breathing organs. When alarmed by the approach of danger from above, the Whirligig beetle ceases its circling movements, and instantly plunges beneath the surface, taking with it a large air-bubble wherewith to supply its needs during its temporary absence from the surface.

The Great Water Beetle (*Hydrophilus*) is one of the largest of our British beetles, and while it somewhat resembles Dytiscus in general appearance, differs from it completely in habits, for it is sluggish in its movements, and is a vegetarian. It is of uniformly deep black colour, and more convex in shape than Dytiscus. Hydrophilus also rises to the surface to take in its air supply; it comes up head first, and by a peculiar movement of the antennæ causes the air to descend to the fine hairs that clothe the thorax or chest, and these in turn pass it on to the openings of the breathing tubes. Curiously enough, although a vegetarian in the adult stage of its existence, as a larva Hydrophilus is carnivorous.

During the spring and early summer we may frequently see at the bottom of a clear shallow pool the untidy bundle of small twigs, or leaves, moving slowly and cautiously along, which indicates the presence of Caddis-worms.* It is a very interesting experiment, carefully and without injury, to rob a Caddis-worm of its tube, and to place it in a saucer of water containing some fragments of twigs, leaves, sand, etc. The insect will at once set to work to collect the pieces of twigs, and weave them together into a new protecting garment.

F. MARTIN DUNCAN.

*See page 571.

THE SOUTH DOWNS.

From the Water-Colour Drawing by Copley Fielding in the Victoria and Albert Museum.

LAKES AND THEIR FORMATION

By J. LOMAS, F.G.S., A.R.C.S.

WE can sum up the characteristic feature of a river in one word—activity. Every drop of water coursing through its channel seems to have a set purpose in view, and hurries along as fast as it can consistent with the jostling against its fellows and the hindrances caused by obstacles in its path. But mounting and sinking, eddying and turning, it never rests. Its power to overcome difficulties and to accomplish its purpose is mainly kinetic.

Contrast this with the lake which interrupts for a time the progress of the river towards the sea. Here the dominant feature is tranquillity. The varying phases of the lake reside not so much in itself as in its environment. It borrows its moods from the glint of the sun and the passing cloud shadow. It mirrors steep crags and gentle pastures, and on its still surface "float double—swan and shadow."

The storm gust rushing down from the encircling heights may for a time ruffle the surface into waves, but in the depths all remains calm and silent. The energies possessed by a lake are potential rather than kinetic, but where the waters leave to form the river anew the stored up energy again takes on the active form.

In passing through the resting stage the river changes many of its characteristics. It enters a fitful uncertain thing, now strong, when in flood, now feeble, in times of drought. It leaves a constant, steady stream, and may be relied upon to do its task in all weathers and at all times. It enters, mud-stained and carrying a burden gathered from the mother hills ; it leaves, clear and limpid, clarified from earthy waste, free and unburdened.

But in setting free the river the lake contributes to its own undoing. The carrying power of the inflowing stream is

Photograph by Tomkinson, Liverpool.

"BANKS OF SAND AND MUD FORM A DELTA WHERE THE CURRENT ENTERS THE LAKE."
Rydal Water.

"THE SWAMPY FLAT INDICATES THE FORMER EXTENSION OF THE WATER."
Head of Haweswater.

lessened when its motion is arrested by the tranquil waters, and banks of sand and mud form a delta where the current enters the lake. The finer sediments discolour the water far into the lake, but they gradually sink to the bottom until finally only the minutest specks of ultra-microscopic dimensions are left suspended in the liquid. A tumbler of water taken from this zone would appear to our coarse senses clear and spotless, but the tiny particles become apparent when the more delicate effects of colour are produced by the filtering of the sun's rays through the medium. The wonderful shades of blue and green which delight the eye when gazing into the depths of lakes fed by turbid streams are the direct products of the interference of these particles on the sunlight which falls on their surfaces and penetrates into the depths. The constant deposition of material causes the delta to spread, and the tract of low marshy ground at the head of all lakes fed by muddy streams is a measure of the infilling which has taken place. Through this swampy flat which indicates the former extension of the water, a narrow channel is kept clear in the direct line of flow.

Tributary streams, too, entering at the sides deposit the *débris* they carry in suspension, and fan-shaped deltas grow out from the banks towards the middle. On the western shore of Tal-y-Llyn, near Cader Idris, one of these fans has crept far into the lake. In the Straits at Haweswater, only a narrow channel intervenes between the delta of the Measand Beck and the opposing shore. In course of time the lake may be spanned from shore to shore; thus it becomes divided into upper and lower parts, whose waters are only connected by a sluggish stream which breaches the barrier on the side opposite to the entering tributary. With this in view it is not difficult to account for the fact that a great number of our lakes occur in pairs. Derwent Water and Bassenthwaite Water, once continuous, have been severed by the waste brought down by the Greta, Newland's Beck, and other minor streams. Grasmere and Rydal Water are spanned by the delta of the Dunney Beck; Buttermere and Crummock Water by Sail Beck and the neighbouring brooks. In North Wales we have Llyn Peris and Llyn Padarn, and in Ireland the two lakes in the Valley at Glendalough.

Water-loving plants soon get a foothold in shallows of the deltas, and the rate of deposition is rapidly increased as the muddy water is strained through the matted sieve of roots and stems. The growth of water plants is an important factor in the infilling, not only at the head but also on the shallow margins of the lake. The plants march in regular order

from the banks towards deeper water. The advance guard consists of such forms as *Myriophyllum* (the Water Milfoil), *Potamogetons* (Pondweeds), *Hippuris* (Mare's Tail), and *Chara*, whose parts are wholly or in large measure submerged beneath the surface of the water. Then come the plants with floating leaves such as *Nymphæa* (Water Lily), and the broad *Potamogeton*. Next we find the Reed zone, whose roots, and portions of their stems, are submerged, while the main portion of their vegetative parts is above the surface. They flourish where the depth of the water does not exceed four feet, and include such forms as *Phragmites* (the Common Reed), *Scirpus lacustris* (Bulrush), and *Typhas* (Reed Maces). Behind these, in still shallower water, is a dense growth of Iris, Juncus, *Gallium* (Bedstraw), Orchids, Water Forget-me-not, Spiræa and Meadow-sweet. On the verge of the dry land we meet with a grassy zone with *Carex* and *Scirpus*, the King Cup and Cuckoo flower, and the rearguard consists of Alders, Willows, and other trees, whose roots strike deep into the waterlogged soil. Floating plants such as Duckweed, Bladder-wort, and the Water Violet may extend into the interior beyond even the submerged zones. It does not follow that in all waters the same assemblage of plants will be found, but the same physiological zones are met with, the species occurring at any one place being dependent on local conditions. Year by year dead leaves and other vegetable products sink to the bottom, and gradually raising the floor, the marginal forms find their proper habitat nearer and nearer the middle. Eventually the whole basin may be filled, and its former site is marked only by a peaty soil.

Thus we come to see that lakes are only evanescent features, and none can claim any great antiquity. Their presence in the landscape is a sure sign that the drainage system of which they form a part is young and immature. They are but incidents in the life of a river. Similar conclusions as to their age are reached when we consider the distribution of lakes of this class. In Great Britain they are only found in areas which were overridden by glaciers in the great Ice Age. The same associations hold good in North Germany, Scandinavia, Russia, and North America. We know that during the ice period the ordinary drainage of the countries affected was interrupted and modified. When the ice melted away many rivers found their old beds filled up, and they were forced to discharge their waters along new channels. We cannot count in years the time which has elapsed since the Ice Age, but we know that it is one of the most recent events in the Earth's history, and the rivers in developing new

Photograph by Tomkinson, Liverpool.

"ONE OF THESE FANS HAS CREPT FAR INTO THE LAKE."
Tal-y-Llyn.

lines of drainage have not had sufficient time to mature their courses. They are now engaged in grading their channels, filling up hollows and removing obstacles, and, given time enough, they will again attain perfect adjustment.

We are now in a position to inquire how the drainage of a country may be disturbed in such a way as to produce lakes. Their distribution would lead us to suppose that glaciers were responsible in some or perhaps the majority of cases. Earth movements, too, resulting in upheaval or depression across the line of a valley would obviously raise barriers which would hold up water to the level of the outflow, or cause depressions in which the waters would lodge.

"ONLY A NARROW CHANNEL INTERVENES BETWEEN THE DELTA . . . AND THE OPPOSING SHORE."
Straits of Haweswater.

A glacier may work in two ways. The ice plough may cut more deeply in one part of its course than another, or it may leave a moraine or other *débris* in a valley in such a way as to obstruct the course of the river. When the first of these causes has been at work we get lakes of erosion, and they may be compared with reservoirs excavated below the general level of a valley. They nestle under the steep cliffs of mountain cirques or spread over a valley track, usually where the sides converge to form narrows. In its efforts to squeeze a broad mass through a contracted gap the ice became vertically thicker and moved with a velocity greatly in excess of that flowing through the broader parts of the valley. The resultant effect was to overdeepen the floor, and a hollow was cut out of the solid rock. If the rim of the basin can be followed all round without a break, and the outflow is seen to be over solid rock, there can be no dispute as to the origin of the basin, but very frequently the ground is strewn with glacial *débris* which hides the true relationship.

Turning now to those lakes formed by earth movements, we must seek for them in places where the crust has been subject to changes of level in recent times. The chain of lakes in the basin of the St. Lawrence river affords conclusive proof that changes of level have taken place since the Glacial Period, and the tilting may still be in progress. Earth movements may result in the production of faults or fractures, and when the land between two fractures has dropped, or, what comes to the same thing, when two areas are raised, leaving a part between unaffected, we have a trough or rift formed. If the floors are inland and below sea level, or at a lower level than the drainage system of the country, water must lodge in them and form lakes. One of the best known rift valleys runs in a north and south direction through Asia Minor far into the interior

Photograph by Steele, New Brighton.

"THE MUDDY WATER IS STRAINED THROUGH THE MATTED SIEVE OF ROOTS AND STEMS."
Ullswater.

Photograph by G. Bingley, Headingley.

A LAKE OF EROSION.
Llyn Idwal.

Photograph by G. Bingley, Headingley.

"THEY NESTLE UNDER THE STEEP CLIFFS OF MOUNTAIN CIRQUES."
Llyn Llyn-Caws.

of Africa. It is of gigantic size, and is marked by a chain of lakes—the Dead Sea, Lake Rudolf, and others—some of which have floors beneath the level of the sea.

Another great valley of depression exists in the Western States of North America. In Oregon, Nevada, and in California, are vast areas 300 feet or more below sea level. They represent blocks which have fallen between mountains rising to 8,000 to 9,000 feet above the sea. Torrents flowing from the high grounds in the rainy season produce lakes in the depressions, and in arid regions the waters are evaporated during the dry season. Thus there remain only flat muddy deposits, bordered near the hills with torrential gravels and sand. But the water flowing from the high grounds contains salts in solution, and as these are left behind when the water is evaporated, deposits of salt, gypsum, borax, and other substances are left behind. Soil impregnated with these substances is unfit for the support of life, and the places covered by this become deserts. Salt lakes are found in all desert areas. Although the climate of our country does not admit of the production of salt lakes at the present day, we have reason to believe that the salt deposits of Cheshire and other places represent accumulations formed in lakes when the rate of evaporation exceeded the water brought into them by streams.

J. LOMAS.

Photograph by Tomkinson, Liverpool.

"THE GROUND IS STREWN WITH GLACIAL *DÉBRIS*."
Easdale Tarn.

GRASSES OF THE WOODS

By MAUD U. CLARKE

With Photographs by HENRY IRVING

ADAPTATION to locality being the great law concerning Nature, we always find this response shaping the species according to the situation or habitat, so that there is an interweaving and solidifying of the compact. For the species is moulded by the habitat, and the habitat in time is characterised by the species.

The sheltered slopes of land that lie below the windy spaces of the hill-tops present two important factors for success in the life of vegetation, warmth and moisture. Here our woods became established in bulk, many varieties of trees forming dense belts of shelter for lesser shrubs and plants. The trees being responsive to the conditions of situation, formed a habitat that reacted upon the tribe dwelling beneath them, and of that tribe the Wood Grasses form a distinct family. Perhaps not many ever consider the Wood Grasses at all. The trees stand first as notable objects for admiration; and the flowering under-shrubs and plants attract attention generally. Yet one can scarcely turn in memory to the woods without recalling those broad areas of green blades that pierce the dry leaves in spring, or the handsome isolated tussocks of grass that thrive in the moist shelter of trees.

WOOD MELIC.

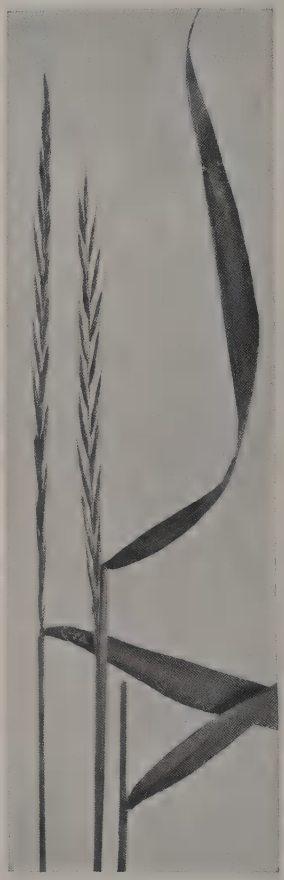
There is something about a colony of the Wood Melic (*Melica uniflora*) that at once attracts the attention as being grass, and yet in a subtle way differing from that of the open spaces. Impressions are sometimes exceedingly difficult of exact explanation; yet one fact concerning this grass may offer something towards an explanation, since it holds the leaf-sheath closed after the manner of the Sedges, although in other respects it is classed separately from them.

In May and June, when the wild hyacinths are colouring the woods with their purple-blue, the Wood Melic raises its slender flower stems of few spikelets. The stems are exceedingly fine, trembling in any draught of air that filters through the undergrowth, the whole

construction being fragile in character. It is a one-flowered grass, the fruit-bearing scheme being comparatively attenuated as compared with other grasses. The plant with the creeping rootstock is always the one to make colonies for itself and force aside other species. In this way the Melic may spread itself at the foot Melic is reduced to an almost spike-like raceme hanging the brown or purple flowering glumes all on one side. It is also a simply constructed two-flowered grass, producing those flowers early in the year during May and June, and in habit a perennial; both varieties average from one to two feet in height.

MOUNTAIN MELIC.

WOOD SMALL REED.



BEARDED COUCH.

of a group of beeches where the smooth trunks rise from the dark leaf-soil in comparative bareness. Here the carpeting of green blades will hold its own, even choking out the Dog's Mercury, another colonising plant that splashes the dry leaves with its strong, dark green foliage.

Melica nutans, or Mountain Melic, although a shade-loving species, grows in more rocky regions where, maybe, stunted bushes give shelter. In this species the slender spreading panicle of the Wood

One of the commonly known grasses of our damp woods is the Millet Grass (*Milium effusum*). It is the only British species of that family, and a very handsome one, raising, as it does, erect, strong stems of four feet, with fine branching panicles of small glumes that catch the glint of the light as it drops down through the trees on their smooth surface.

Usually the ground surrounding the tussocks is mossy with perhaps the brilliant green of the Fern Moss or grey

flecking of the Trumpet variety, and a flush of Scarlet Elve Cups on the rotting twigs.

The blades of the Millet Grass are broad, flat, and thin, curving in graceful profusion below the flowering stems. In the gaps between the young hazel and ash, where due shelter is given all round it, the grass lives in favoured conditions; giving shelter in its turn to the White Woodruff, Yellow Pimpernel and Purple Ground Ivy.

Another of our fine grasses is the Wood Small Reed (*Calamagrostis epigeios*). The term "Small Reed" seems a little inappropriate when designating a species that attains five feet in height. It is a stout, erect grass with a crowded panicle of many purple spikelets shortly awned, sometimes measuring as much as a foot long. It likes the more open spaces in our woods where it is free to air and light, yet has the sheltering ring of growth round it. We cannot, however, claim that it is a commonly found species, for it is more local in habit than others. When not interfered with it makes strong root-hold, flowering through June to August.

WOOD POA, OR MEADOW GRASS.

Agropyrum caninum, or Bearded Couch, is perhaps more often found on the outskirts of the woods, just within the ring of shelter or bordering the wood tracks. This is a fibrous-rooted species with three-foot stems and bright green spikelets possessing two to five flowers, the flowering glumes having long awns. The strong, broad blades, projected from the leaf-sheaths, resemble those of wheat, and the name *Agropyrum* is derived from two Greek terms meaning respectively a field, and wheat. The plant is a perennial and flowers through June and July.

All these strong-growing perennial grasses make covert for a most varied assortment of insects and their larvæ, and I have watched hedgehogs on the warpath most industriously quartering every foot of the miniature jungle.

In contrast to the solid growing varieties is that fine trailing species that almost suggests spray in its panicles, the Wood Poa, or Meadow Grass (*Poa nemoralis*). Rather a feeble grass, it props upon the surrounding growth, or soon trails on the bare ground. Although attaining three feet of height, it is a slender scale of growth, the leaves being very narrow, and the loose panicle composed of very small spikelets. They are green or purplish in colour, and generally three-flowered, extended upon branchlets that have a waved line of formation.

The plant is slightly inclined to creep, is perennial, and quite a commonly found species in our woods and copses. In autumn the dry glumes have rather a greyish tint than tawny, which suggests spray or mist drifting above the green undergrowth. The form of the panicle may remain perfectly expanded, but the glumes, empty of the seed, contract closely together.

Quite distinct in type, the Slender False Brome (*Brachypodium sylvaticum*) sends up its erect, solitary flowering stems of one foot or even three feet in height amongst masses of hairy blades. The number of spikelets is usually seven or eight, carried on a slender curving stem that is indented for their reception, since they stand loosely away from it. We are quite familiar with the broad, often yellowish green blades springing among the shrub-growth, or on the outskirts of the woods, although

it is equally a hedge grass, and, indeed, met in the odd corners also. For grasses have a fashion of their own in often evading restrictions and turning up in out of the way places. The varieties of the Brome family are many, and this one is recognised as having broad, long hairy leaves with something of the tufting character as shown in the right-hand specimen of the illustration. There are often late flowering stems found in the autumn, when the blades have acquired that dull brownish-green colour that means stagnation in the sap, and heralds the fading into the bleached whiteness of the winter months.

SLENDER FALSE BROME.

I think, perhaps, by those who are genuine wood-prowlers, who never cease to find woods of interest even in the winter, and from sheer force of habit turn up the familiar tracks day by day, the grasses can be studied to purpose in their dry dead state.

When all the wood plants have seeded, and a cool moist silence pervades the shelter of the trees, then the dry grass-stems stand up and take their part in the uniform order of things. Faint straw-colours, or bleached greys, take the place of vivid greens among the wet leaves, but the individual forms are all still distinct, although in shrunken condition. One cannot mistake a stem of the Cocksfoot Grass that springs beside the grass track for any other, nor does the autumn bearing disguise the Millet Grass, still stiffly erect above the almost evergreen mass of blades. In the dry areas of the wood where the dead seeded capsules of the Campion tangle are all that show of its summer beauty, there is the Slender False Brome fringing the rabbit-holes. Here and there a patch of the Soft Grass shows still bloomy in young shoots that have ventured up among the curled dry ones. The Tufted Hair Grass, too, in the wet hollows shows a series of dry lance-like stems, or the broken angles of those subjected to accident. It is grass everywhere, save where the dripping bracken and bramble vines hold the ground too densely.

This accumulation of the dead grasses above the earth, and strong massing of the fibrous rootstocks below, acts most beneficially for the protection of numberless seedling plants through the low temperature of winter nights. The superficial mass of dry stuff keeps the moisture from evaporating, and considerably modifies the bite of cold. The exquisite green leaves of the Wood Oxalis keep their brilliancy often through winter down among the mosses at the foot of dead grass; and many an earth bank facing to the cold winds on the outskirts of the wood has its plant world comforted by the protection of the grasses. Dead or alive, they are of value in the grand economy of purpose that Nature displays when left to its own ruling.

MAUD U. CLARKE.

HOW TO KNOW THE WILD ANIMALS

By DOUGLAS ENGLISH, B.A., F.R.P.S.
Author of "Wee Tim'rous Beasties," "Beasties Courageous," etc.

THE BROWN HARE THE RABBIT

With Photographs by the Author

"Pulling her hand out of mine she ran back to where the dead Hare was lying, and flung herself down at its side in such an agony of grief as I could hardly have believed possible in so young a child. 'Oh, my darling, my darling!' she moaned, over and over again. 'And God meant your life to be so beautiful.'"

The Rev. C. L. DODGSON (Lewis Carroll) in "Sylvie and Bruno."

"No doubt Englishmen are the sportsmen of the world, but our Continental neighbours entertain a friendly rivalry with the Saxon, and the number of Hares which are annually killed at big drives in Austria represent enormous figures, beside which statistics of our English sport are dwarfed into sorry insignificance."

The Rev. H. A. MACPHERSON in "The Hare." (*Fur, Feather and Fin Series*).

HARES, Rabbits, Pikas and the Romerolagus, a quaint little Mexican beast which has been recently discovered, belong to a sub-order of rodents whose members, owing to their possession of four upper incisors in place of the more usual two, are called Duplicidentata. All known Duplicidentata are terrestrial, and all possess insignificant tails—indeed, Romerolagus and the Pikas have no external tails at all.

In Hares and Rabbits each front upper incisor is deeply scored down the centre, and therefore presents at its fined extremity two separate and narrow cutting edges. Behind each front incisor lies a smaller tooth, which no doubt strengthens the stability of the tooth before it, and also limits the depth of its penetration. We may assume from this structure that the shavings, which are the joint work of upper and under incisors, are extremely fine, and this fineness of cut is sufficient to account for the ease and speed with which the animals bark young trees. It is possible that the rodents are descended from the extinct Tillodonts, whose most recent representative, the bearish Tillotherium, possessed, like Hares and Rabbits, an additional pair of small upper incisors. This suggests that Hares and Rabbits are a primitive type.

YOUNG RABBIT.

It is probably familiar to most of my readers that the differences in structure, habit, and character between the two species date from their earliest infancy. The young Rabbit is born in a burrow, blind, naked and small. The young Hare is born round-eyed, furry and sizeable, in the open.

Taking the Hare-Rabbit family as a group, it is of little moment whether we assume that Hares have abandoned burrows, or that Rabbits have abandoned the open, or that the

two types are divergent offshoots from less highly specialised ancestors. It should be noted, however, that many instances have been recorded of Rabbits constructing their breeding nests above ground, and of Hares depositing their leverets under substantial cover.

Though the fact that Hares breed almost throughout the year has long been known, the number of leverets in a normal litter was, until quite recently, a disputed question. It is now generally agreed that this number is usually five, and that the doe disposes of her progeny in two or three separate breeding "forms," which she visits regularly, and from which, if she suspects danger, she transfers them. It is not usual to find more than three leverets in one "form," but I have seen an excellent photograph of Mr. Farren's showing five, and I think it likely that five leverets which are born together will be left together for a day or two. In cold weather this disposition would certainly be advantageous.

BROWN HARE.

Of all wild babies the leveret is the most lovable. I have never chanced on one which I have not felt tempted to appropriate (sometimes, I must confess, I have succumbed to the temptation), and I have never seen a photograph, or drawing, which suggested a leveret's innocence. A leveret's coat is curiously touzled (as though the owner needed a good brushing), but in this "touzling" we see something of Nature's method, for the light and shade of it, combined with a pepper-and-salt coloration, give exactly that "speckliness" which is of all colour combinations the least conspicuous.

Sometimes a leveret can be taken up quietly, but more often, if he is of any bulk at all, he will put up a laughable fight with his fore feet, and, if you still insist, will utter reiterated screams, like those of an old-fashioned squeaking toy. It is of little use attempting to rear a leveret who is only a few days old, unless one can provide him at once with a foster-mother—the domestic cat has often been pressed into service. Should, however, one chance upon a leveret a fortnight or three weeks old, who is stocky in build, and capable of nibbling soft "tops," little difficulty will be experienced in rearing him if one can school oneself to respect his instinct for dozing away the daytime under cover.

In rearing young wild animals over-attention is just as fatal as neglect.

To return, however, to the leveret at home. In order to see him clearly, the grass, or whatever shelters the "form," must be parted, and, even when this is done, one need only turn one's head to lose him. His ears, compared with those of the grown hare, are distinctly short, but his eyes are almost as large and lustrous as his mother's, and the greater relative extent of the light fur-patch between eye and nostril, combined with the relatively blacker muzzle, so break up and confuse the outline of his head, that it needs a trained eye to see him two yards off.

He is, in fact, admirably specialised for avoiding observation. He needs to be; for it must be remembered that, from the moment of his birth, he has no more than a flimsy grass-screen to protect him, and in this respect, so far as British animals are concerned, is uniquely defenceless. Much of his protective coloration he carries with him to maturity. An adult Hare's ears are between four and five inches long, and present on their hind (or under) surface, a remarkable colour-scheme. Starting from the root-ends one finds first about one and a half inches of thick brown fur, then about two and a half inches of sparse blue-grey

fur, and finally at the extremities well-marked triangles of silky black. A wild Rabbit's ears are also black-tipped, but the body colour of them is brown, and

WILD RABBIT.

this merges gradually into the black. When a Hare is at rest in his "form," his ears are laid back flat. In this position the patterns of the hinder parts of them are completely concealed, and the same thing happens when the Hare is extended to a gallop. When, however, he is lilting at his ease, or frolicking, or sitting up to listen, his ears are erect and expanded, and the markings, as seen from behind, are extremely conspicuous.

Mr. Kay Robinson has suggested that when a Hare's ears are projected above surrounding herbage, the black tips may have a protective value, inasmuch as the Hare's enemy would be naturally on the look-out for something *brown*. He quotes in support of this an interesting experience of his own. "My first idea," he writes, "was that they (the black-tipped ears) were some large black-and-brown butterfly with spread wings on one of the turnip leaves." (*Country Side*, May 12th, 1908.)

Mr. Kay Robinson's suggestion, ingenious though it be, is, in my judgment, untenable. In the whole scheme of nature-colouring there is nothing so arresting as black. An isolated black object above shadow level screams for notice, and Mr. Kay Robinson's attention was attracted, as that of any other good naturalist would be, by the blackness of the Hare's ears. Anything which attracts the attention of man, let alone that of raptorial birds, would be poor protection for a Hare.

The white under surface (or scut) of a Hare or Rabbit's tail presents another puzzle. It is chiefly conspicuous when Hare or Rabbit is in full flight. With Mr. Kay Robinson's objection to the book-theory that these white "scuts" are guiding signals which enable young Rabbits to follow their parents to the burrow, "in the same way as the soldiers of Henry of Navarre were able to follow their leader's white plume through the thick of battle," I entirely agree. The facts are all against this naïve suggestion. Startled bunnies do not follow each other's tails. It is a case of each one for himself. Some prefer to make for shelter, some lie crouched in the open. They are not remarkably intelligent animals, but they

WILD RABBIT.

have sufficient intelligence to avoid a procession in line ahead.

Both Hare and Rabbit being normally twilight feeders, it is conceivable that

the white scuts may serve a purpose in keeping the does and young together, but we must not forget that the white is most conspicuous in the bucks and that the diameter of the eyes in Hares and Rabbits indicates a very sensitive vision. The iris of a Hare's eye is golden brown, and the diameter of the pupil is slightly less than that of the pupil of a Rabbit's eye under similar conditions of lighting.

LEVERET ABOUT THREE WEEKS OLD.

In consequence of this the Hare's eye presents a bolder, more hawk-like aspect than that of the Rabbit, whose iris is often of a chocolate colour. The contracting power of a Hare's pupil appears to be somewhat limited, but the position and size of the eye, as a whole, imply an extended range of vision, and the fact that when pursued a Hare is concerned with what is behind him even more than with what is in front (hence the exquisitely timed "double") has led to some curious accidents. I have known a case of Puss completely flooring a man who had stooped to a half-sitting position, with his arms extended, to head her from a gap. Daniel gives an instance of a Hare colliding with a terrier end on. In this case the terrier was stunned and the Hare's skull smashed. I am not aware that the speed of a galloping Hare has been properly determined, but putting it fifteen per cent. less than that of a first-class greyhound, one may assume that it is not far short of thirty miles an hour. A ten-pound Hare travelling at this pace would be quite an effective projectile.

The ordinary length of a Hare's pace is about a yard, but when pressed Puss is capable of a great effort. Major Barrett Hamilton has recorded a leap of ten feet accomplished by a Hare running from a dachshund, and the normal standing leap from the "form" is often more than two yards.

As can be most easily determined by snow-prints, when the snow is of suitable consistency, the running Hare's hind feet strike the ground in front of the fore feet. The same "bucking" progress characterises the Rabbit, but in his case the hind feet come down side by side, whereas in the case of the Hare one is always a little in advance of its fellow.

Though I have seen five Hares simultaneously engaged in my one cabbage patch, the Hare is by nature a "solitary." His "form," in which he dozes through the day, is usually on high, dry ground, and fastidiously selected with a view to making the best of the prevailing weather. He seldom quits it before nightfall, though after a prolonged spell of bad weather hunger may occasionally impel him to feed by daylight. Normally he spends the day in digesting his last night's bellyful. Mr. Drane, who has contributed greatly to our knowledge of the Hare, has described an extraordinary habit which he has found to accompany a Hare's normal digestion. I must content myself here with informing the reader that the Hare does not "chew the cud" in the ordinary sense of the term, and must refer him for further details to Mr. Drane's papers in the transactions of the Cardiff Natural History Society, 1894-5.

Hares have frequently been kept in confinement, and every one who has kept them, and gained their confidence, is agreed as to the fascination of their ways, and the affection which they display towards their keepers.

Of the many wild creatures who have passed through my hands, and who, I think I may fairly claim, have honoured me with some show of confidence, the Harvest Mouse, the Badger and the Hare have appealed most to my sympathies.

I can add but little to the observations made by others on captive Hares. A question which has puzzled several observers is whether Hares ever close

STUDIES OF THE BROWN HARE.

their eyes in sleep. Mr. Drane has no doubt on this point; he declares, without qualification, that a Hare *does* close his eyes in sleep. That I have never seen a Hare close his eyes and retain them closed voluntarily for any length of time, is probably due to the fact that I have never gained a Hare's confidence so completely as Mr. Drane. That a Hare can close his eyes is indisputable. He will sometimes do so temporarily while you stroke him.

FORE PORTION OF A LEVERET'S UPPER JAW.

Showing the small incisors' situation behind the larger ones; a peculiarity of dentition which is characteristic of the Hares and Rabbits.

Millais quotes with approval Zola's description of a Hare's eyes as presenting "a bleak and frigid stare which does not seem to see," or, "an ever-haunting absent look as of one whom her sufferings overwhelmed." With these flowers of rhetoric no one who has kept a Hare can agree for a moment. A Hare's eyes are singularly expressive, and, of all the qualities which can be predicated of them, width and intelligence of vision are the most obvious.

One of the many engaging attributes of a Hare is his method of displaying resentment. Chuck a Hare under the chin, and he will rear on his hind legs, grunt angrily, and drum with his fore feet on your hand. This drumming (quick alternate strokes of the fore paws) is the Hare's main method of defence. His attack is a double-barrelled flying kick like that of the Rabbit. The drumming habit has been so taken advantage of, that instances are recorded of Hares having been trained to play tambourines. The performance seldom lasts long under ordinary conditions, for, realising its inefficiency, Puss soon relapses into sulks, with a look which shows as plainly as speech that your attentions are a little childish. He is far too much of a gentleman to bite, though he may nibble at your hand; biting is left to the Rabbit, whom Mr. Drane rather unkindly characterises as a "little cad." Mr. Drane's conception is probably based on the unsportsmanlike instinct which impels the fighting Rabbit to "bite below the belt." The Hare shows a strong aversion to the Rabbit, perhaps for this reason.

A few other peculiarities of the Hare may be noticed. On rising from his "form" he often throws back his head, arches his hindquarters, and stretches from the fore feet backwards—wild Rabbits often make a similar back-stretch. Sometimes he stands up on end and shakes himself while standing, a movement which is always accompanied by a quick shuffle of the fore feet. He has several curious basking positions. A favourite one is the fullest possible extension of himself, with his hind legs pointing backwards, and his fore legs pointing forwards. In another, both hind and fore legs are pointing forward, and the great length of his hind legs brings all four of his feet in line, with his head thrown back behind them. Like a Rabbit, he is incapable of lying on his back, or in any curled position, and I have never seen him lie with both hind legs on the same side of him and his body skewed round—a position which Bunny Rabbit is rather fond of.

There is some question as to the voice of the Hare. Only two sounds have come within my experience. If annoyed he makes a snuffling grunt of disapproval, and if in an agony of fear, he utters a loud scream, which, like the leveret's, has the same quality as the squeak of a pneumatic toy.

"Hare-pipes" are frequently mentioned by the old writers, and also in the Statutes relating to game. In the latter they are, I think, without exception, placed in the same category as nets and gins, and it is, to say the least of it, doubtful whether the expression was ever used by an authoritative writer in any other sense. It is right to point out, however, that several

good observers hold that both Hares and Rabbits have call-notes, and it is conceivable that "Hare-pipe" may on occasion have denoted a musical instrument used for producing a Hare call artificially. Calling out a Hare is not quite the same thing as calling out a Rabbit. In the case of gregarious animals it is well known that the squeal of one member of the community in distress will often bring up others. In his delightful book, "Wild Traits in Tame Animals," Mr. Louis Robinson suggests that the outcry of the doomed pig is a last despairing summons to his kind. It may be so from poor piggy's point of view, but I doubt if the motives which inspire his companions are purely altruistic, and I think that when a young Rabbit voices his misfortune, the instinctive desire of other Rabbits in the vicinity would be to suppress, as quickly as possible, a noisy and indecorous advertisement of the warren.

More, perhaps, is known of the daily round of the Rabbit than is known of the daily round of the Hare, but of the whole cycle of a Rabbit's life from year's end to year's end we have no certain knowledge. So far as his relations to the outer world are concerned, his chief concern appears to be that he shall have ample and dry space for breeding purposes. An ideal site for a warren is a sandy slope of heath-land, edging a pine-wood, with a south or south-west aspect. If, in addition to the ordinary heath-land vegetation (implying cover), there is cultivated land a short distance below, so much the better for Bunny. Although when the weather is favourable he, as often as not, lies out in a "form," the greater part of his existence is spent in the recesses of the burrows. We can only conjecture as to the conditions of this life, but it is probably safe to assume that in winter a number of Rabbits cuddle together for warmth, and that in hard weather they can pass a succession of days in a semi-torpid condition. The extraordinary fecundity of the doe Rabbit—she litters four or five times in the year, and there may be as many as eight or nine in a litter—necessarily has a direct effect on the economy of the warren. At the approach of the breeding season, say in late February, it would seem, from the shoots of sand at the entrances of the holes, that a number of Rabbits who had wintered together had broken company, and that a general spring cleaning was in progress.

The first warm settled evening will bring Bunny out of his burrow. First comes the buck (to be recognised by his heavier head), who after much preliminary sniffing, a hurried toilet, and an impatient scratch at the ground in front of him, bounds off to his feeding ground, ears up and scut in rest. The doe follows, but, her responsibility being greater, she seldom ventures far. "Little and often" is her motto, and for this reason, I fancy, she not infrequently sallies out a short distance at midday. During the small hours she scratches out a burrow for the reception of her young, and lines it with her own fur. These breeding-holes turn up in unexpected situations, often at some distance from the main warren. In any but the coldest months young Rabbits are in evidence. Litter succeeds litter, and the neighbourhood of

HARE IN ITS "FORM."

a warren on a warm summer's evening presents a pretty picture. The bucks, all bounce and swagger, leaping across each other's backs, kicking, scratching, stamping; the does stretched out contentedly, or nibbling for the sake of doing something; the babies, of all sizes, and in all conceivable positions, sitting up like mother, scratching themselves like mother, "fondling their foolish faces," scuttling before imaginary danger, crouching before imaginary shadows. Sometimes the danger is real—the cry of a hawk, the rustle of an adder or a stoat, the step of man. "*Thud, thud, thud!*" from one end of the warren to the other. The old Rabbits are stamping with annoyance. Up go the tails, the white scuts bob and flutter, and in a moment the warren is empty. Walk slowly forward. Rabbit after Rabbit will start up from beneath your feet. Stoop down and listen. You will still hear them stamping.

DOUGLAS ENGLISH.

HOW TO KNOW THE TREES GROWING IN BRITAIN

With Notes, descriptive and photographic, for their Identification in all Seasons of the Year

By HENRY IRVING

THE APPLE AND PEAR GROUP*—I

THIS group, as already stated, is closely allied to that of the Plum and Cherry, being of the order of the Rose. In the trees of this group the fruit is formed beneath the calyx, which as a dried rosette or crown remains attached till the fruit is ripe.

THE CRAB OR WILD APPLE

The usual habit of this tree is to divide into branches rather low down. These spread outwards and upwards somewhat irregularly, so that the crown is low and rounded. There is often considerable density in the lesser branching, suggestive of a thicket of shoots and twigs. The sight of the Apple tree in full bloom, whether wild or under culture, fills one with a kind of amazement. The mass, the fulness, the warmth of colouring, its suggestive sweetness, set this tree apart from all others. It seems to crown the floral beauty of the season.

BARK AND TRUNK OF APPLE TREE.

The greyish

* Includes the Apple, the Pear, the White Beam, the Wild Service, the Rowan, and the Hawthorn.

AN APPLE ORCHARD IN BLOOM.

TRUNK AND BARK OF WILD PEAR.

TRUNK AND BARK OF WHITE BEAM.

brown bark is scaly. The twigs are smooth, and of a reddish brown. There are many dwarf shoots with ringed scars. The buds are small, and protected by scales on which are some whitish hairs. The leaves vary in form from a rounded to a long oval. They show distinct serrations along their margin, and have pointed tips. Five or six pairs of strong secondaries branch off from the midrib, and curve forwards, but they soon divide. The flowers grow singly on short stalks, several of which emerge together at the tips of the dwarf shoots, or spurs, and, spreading outwards, form bunched clusters. The five petals to each flower are pink and white, and within the cup formed by these is a circular group of many stamens, each with a creamy yellow head, erect after the second day of opening. The familiar rounded fruit shows always a distinct depression at the base where the stalk enters, as well as at the top where the calyx is still attached. The firmly coated brown seeds, or "pips," in pairs, are disposed in five separate walled cells, which constitute the Apple's "core."

1 2

TWIGS (1) OF THE APPLE; (2) OF WILD PEAR SHOWING BUDS AND DWARF SHOOTS.

LEAVES OF WILD PEAR.

THE WILD PEAR

This is not a common tree, and is probably often a mere escape from cultivation. In comparing it with the Wild Apple the following details may be noted.

The shape of the tree is usually taller and less spreading. The branching is more open, and with less entanglement of the twigs. The bark is more distinctly furrowed, and less inclined to flake off in scales. The twigs are a yellowish brown, and are without hairs. The buds are hairless. The leaf margins show only ill-defined serrations. The venation of the leaves is less distinct, the secondaries, though more in number, are weaker and more sinuous, the whole system breaking up into a more or less complete network of nerves.

The flowers are, with rare exceptions, pure white. They open about ten days before those of the Apple. They are grouped in more distinct and more open bunches. The many stamens stand erect from about the third or fourth day after the petals have expanded, and their tops are a dark purple. The fruit, notwithstanding our familiar use of the term "pear shape" as a descriptive epithet, is frequently round, but it may be readily distinguished by the absence of any depression at its base.

Moreover, the substance of the pear has always a gritty admixture, instantly recognised on cutting or biting.

TWIG OF THE WHITE BEAM.

It will be convenient to regard the next three trees as forming a sub-group. Their flowers, which are small and white, or creamy white, are borne in branched clusters, in such a way that the flower heads arrange themselves more or less in a single plane. The fruits, popularly spoken of as berries, are like miniature apples, varying in colour according to the kind; they are grouped in the same manner as the flowers. They enclose but few seeds.

THE WHITE BEAM

The White Tree—for Beam is the Saxon equivalent for tree—is aptly characterised by its name. Seen in its accustomed haunts, on the borders of the wood, or on the slopes skirting the chalk downs, it cannot be overlooked or mistaken, a mound of greeny whiteness in conspicuous contrast to its surroundings. It varies much in habit from a small shrub to a fairly large single-columned tree; though it most frequently, perhaps, appears as a considerable bush-like tree, with several strong stems spreading upwards from the base.

The grey bark is at first smooth, having dots arranged in short transverse lines. This eventually becomes rough. The twigs are stout, and shining, brown to grey in colour. The buds, spirally arranged, usually stand out from the twig. They are protected by scales, which are green with brown margins. The leaves vary in shape, and have a tendency, more or less decided, to divide into pointed sections, with double serrations on the margin. When young they are grey. On first emerging from the bud they stand up like small grey, or white, pinnacles. After full expansion the upper surface becomes gradually a deep shining green, but the lower surface

LEAVES OF THE WHITE BEAM.

remains white, being coated as with thick felt. It is this under-surface whiteness, lifted and displayed by the wind, which gives to this tree its distinctive character and name as the White Beam. The calyx and stalks of the flowers are coated with this same white felt. The petals of the flowers are white, as are also the tops of the stamens. The fruit is nearly globular, and its colour is scarlet, often dotted with brown.

As a shrub the White Beam may be distinguished, with certainty, from the rather similar shrub known as the Wayfaring Tree, by the spiral arrangement of its buds and leaves. Those of the Wayfaring Tree are opposite.

HENRY IRVING.

CONCERNING THUNDERSTORMS—I

By WILLIAM J. S. LOCKYER, M.A., Ph.D., F.R.A.S.

"We often see, against some storm,
A silence in the heavens, the rack stand still,
The bold wind speechless, and the orb below
As hush as death: anon the dreadful thunder
Doth rend the region."
SHAKESPEARE (*Hamlet*).

EVERY one of my readers has had an opportunity of witnessing in this country the fine display which a thunderstorm presents — when Nature seems to be turned loose for a time. The storms which we experience in these Isles are, however, veritable pigmies when we come to compare them with those that are born and bred in tropical regions; nevertheless, many of us have often felt considerably alarmed even when compelled to be present at the advent of these minor types of atmospheric disturbances.

In spite, however, of the dangers which may accrue from violent thunderstorms, the lover of Nature should welcome their approach. Is there not majestic grandeur in the enormous cumulus cloud which composes the storm, folds and folds of which soar skywards? Is there not interest in the rapid movements in several directions, both horizontally and vertically, of the air currents as indicated by the ever changing positions and forms of the cloudlets? Is there not beauty in the fine gradations of colours—blue, mauve, violet, etc.—as the storm approaches? And, lastly, is there not wonder, perhaps mixed with awe, in the magnificent display of Nature's untied energy as exhibited by the intensely dazzling flashes of lightning and the accompanying, or, rather, subsequent, peals of thunder which reverberate through the air?

With such objects of interest and study before us, some best seen by day and others when the storms occur during the night-time, no opportunity of watching them should be missed. In this way a thunderstorm, which many people look upon as a nuisance, to be dispensed with as soon as possible, may become a thing of beauty, and worthy of the closest attention.

It is a curious fact to note that an atmospheric disturbance such as a thunderstorm—in which torrents of rain fall, heavy squalls of wind are experienced, and almost incessant lightning and thunder occur—is, after all, the result of a very peaceful and serene state of the atmosphere about us.

Most of us can recall one magnificently fine summer's day when Nature seemed nothing but smiles for us, and appeared to be doing her best to make everything as ideal as possible. We can all remember also how our confidence in her received a rude shock by the quick approach of a thunderstorm, which converted serenity into chaos!

When one, however, begins to observe closely, and tries to find out the inner working, so to speak, of Nature's procedure, one is led to the conclusion that there is a greater number of steps in the process of the formation of a thunderstorm than one might at first think, and they are of the greatest interest to watch.

Let us for a moment pass in review the general sequence of changes which are experienced as a storm approaches and passes over an observer during the day-time. By careful watching it will be seen that the blue sky gradually becomes covered with a layer of thin cloud, usually termed cirro-stratus, at a great altitude. This very elevated cloud form

precedes the storm, and may be from ten to fifty miles ahead of it. As time passes, underneath this layer will next be observed thick dark grey and violet coloured clouds of the cumulo-stratus type, and after that grey or ruddy clouds at a still lower elevation. The approach of the main cloud of the storm will now be seen in the distance, and as these low clouds begin to pass overhead, they are seen to be rounded underneath and to have a billowy appearance. The wind begins to rise in strength, and the direction from which it blows becomes reversed. The wind now takes the nature of a squall; but this is short-lived, and is followed by a deluge of rain. Already distant lightning has been dimly seen, and thunder heard; but the storm now bursts over the position of the observer, and is accompanied by numerous brilliant flashes and the loudest of thunder claps. The flashes, owing to the fact that it is still day-time, do not, however, appear so intensely bright as they would if the storm had taken place at night.

"ITS EXTREME WHITENESS . . . RENDERS IT A STRIKING OBJECT."
An embryo thunder-cloud photographed by Dr. Lockyer at South Kensington in 1906.

The moment of the bursting of a thunderstorm is well expressed in the following lines from the "Ingoldsby Legends":—

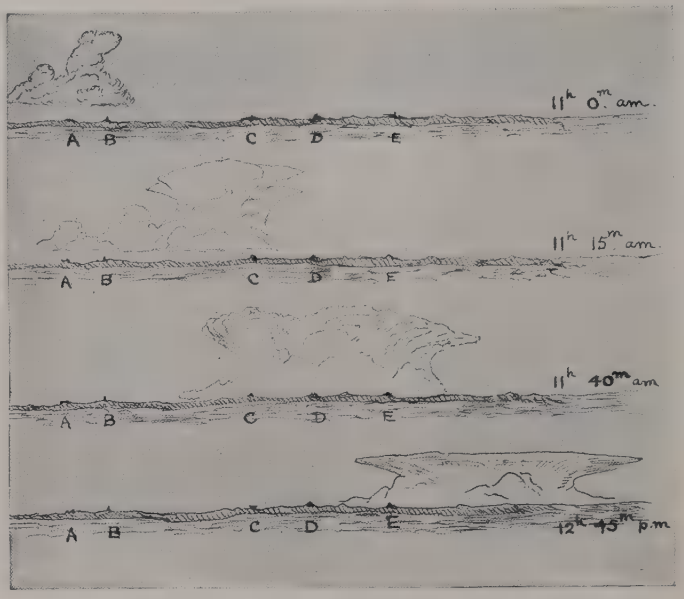
"And then a hollow moaning blast
Came, sounding more dismally still than the last,
And the lightning flash'd, and the thunder growl'd,
And louder and louder the tempest howled,
And the rain came down in such sheets as would stagger a
Bard for a simile short of Niagara."

For some time rain continues to fall in great abundance; but the times of greatest rainfall vary, sometimes being near the beginning and sometimes toward the end of the storm.

Behind the storm the horizon now becomes lighter, clouds in that region are seen detached, and later on blue sky is visible once more. The rain ceases as the last of the storm-cloud passes overhead. The landscape now emerges from gloom to light, the air feels fresher, the temperature, which has been lowered, rises again, and once more serenity prevails.

Thunderstorms, when they come singly, do not last very long, the length of time between the first and last sounds of thunder being on an average about two hours. Very often, however, thunderstorms occur in series, and when one is over another follows in its wake. In some regions, generally owing to the peculiar configuration of the surrounding country, the thunderstorm recurves and passes over the same locality again.

Having now recalled to memory the general features connected with the approach and departure of a "grown up" thunderstorm, let us now consider



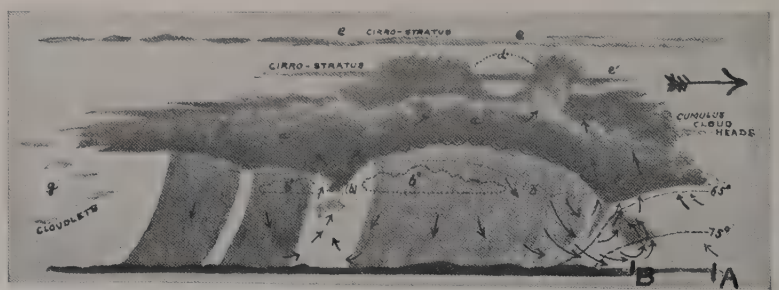
THE GROWTH AND MOVEMENT OF A THUNDER-CLOUD, AS OBSERVED AND DRAWN BY PROF. W. M. DAVIS, AT NEW YORK, JULY, 1887.

the storm from its birth to its fully-fledged state.

In these islands thunderstorms are due to excessive heating of the air at the earth's surface, which causes up-currents of air to rise into the higher regions of the atmosphere. It is only natural that these storms occur most frequently in our summer months, for then the sun is longer above the horizon, higher in the sky at midday, and therefore under the best conditions to heat the earth's surface to an excessive extent.

The rush of warm and moist air into more elevated and cooler regions gives rise to cloud, for there the air is cooled and the water vapour is condensed. Such a cloud is termed a "cumulus" cloud, because it has a heaped-up appearance like a tuft of wool. Now, such a cloud forms the embryo of a thunderstorm. It is at first small, but the continued ascent of the moist warm air makes it in time assume enormous proportions. To watch such a cloud grow in size is of the greatest interest and beauty, for it usually begins to form in a cloudless sky, and its extreme whiteness, with a background of blue, renders it a striking object. As its dimensions increase, fold upon fold tower one upon the other on the upper surface. Such an embryo thunder-cloud is seen in the illustration on page 619, which is from a photograph I secured at South Kensington in the spring of 1906. This cloud, before it passed out of sight, grew to considerable dimensions, the billowy masses rolling upwards tier upon tier, giving it a magnificent appearance.

In the initial stages of formation a thunder-cloud has a flat under surface and a billowy top. It, however, undergoes considerable changes before it can be stated to be properly developed. Perhaps the best idea of these transformations will be gathered from a very interesting series of drawings which were made by a distinguished American meteorologist, Professor William M. Davis, and here reproduced. These drawings show the increasing size and change of form of the thunder-cloud which passed over New York on July 2,



PROF. KÖPPEN'S DIAGRAM OF A VERTICAL SECTION OF A THUNDERSTORM.

1887, and they illustrate at the same time the progressive movement of the cloud over the land.

Looking at the first of the four sketches, the cloud will be observed to be over positions A and B, and to be an ordinary cumulus cloud at eleven o'clock. By 11.15 it had grown considerably, both vertically and laterally, and it will be noticed not only to have travelled to C but to have extended its uppermost front in the direction of travel. At 11.40 its base had decreased in height and its uppermost front and back portions assumed a mushroom or overhanging appearance. The cloud was then over the positions C, D, and E.

In the last drawing, made at 12.45, or more than one hour later, it had nearly passed over E, and assumed the typical form of a well developed thunder-cloud, namely, a form something like an anvil.

When one considers the great mass of cloud involved, the large area over which it extends, and the comparatively small altitude of the under surface, it is not surprising that considerable darkness prevails on the surface over which the storm travels.

The study of a thunder-cloud, with its attendant winds, would not be complete without a brief reference to a very instructive diagram (on the opposite page) which sums up the main facts above described. We owe this diagram to the celebrated German meteorologist, Professor Köppen. This vertical section of a storm displays the anvil-shaped form of the whole mass. It indicates, further, both the high and the low clouds, including the very elevated cirro-stratus cloud, which, as previously stated, considerably precedes the front of the storm. It will also be noticed, by observing the small arrows (which blow with the wind) near the front of the storm, that as the whole storm moves from left to right, the observer at A, who is stationary, will think that the storm is coming up against the wind. As a matter of fact, the observer is only in a large current of air which flows in towards the base of the storm-cloud, and must therefore blow in the opposite direction to that in which the storm is travelling. When the storm has moved on a little, and the observer is at position B in relation to it, he will then feel the full blast of the storm, the wind here being in the same direction as that in which the storm is travelling.

THE FRONT PORTION OF A THUNDER-CLOUD MOVING FROM LEFT TO RIGHT.
Photographed by Dr. Lockyer at Sandown, Isle of Wight, in Aug., 1906.

These apparently opposing wind currents which exist near the front of the storm thus clearly explain the very common statement that a thunderstorm comes up against the wind.

The accompanying illustration shows the profile view of the front portion of a thunderstorm as it moved from left to

right in the picture. This view was taken by me at Sandown, Isle of Wight, in August, 1906, the camera being pointed eastward, and the storm moving from north to south.

The overhanging nature of the front of the storm-cloud is clearly discernible, but the main lower part of the cloud was outside the field of view. In the upper right-hand portion of the illustration, up to the edge of the overhanging storm-cloud, light cirrus cloud and blue sky were visible, but the former was too delicate to be photographed with the apparatus at my disposal.

W. J. S. Lockyer.

HOW TO KNOW THE WILD FLOWERS

By the REV. H. PUREFOY FITZGERALD, F.L.S.

With Photographs by HENRY IRVING

THE FLOWERS OF THE CHALK DOWNS AND PASTURES

A WALK on the downs will bring us into touch with many flowers that will invariably be found in such places; some of these will also be seen growing elsewhere, but generally the down-land is so poor, and has such a small depth of soil, that the plants are frequently dwarfed and half starved, and consequently may not be recognised. This is not the case everywhere, for some downs have greater depth of soil and more moisture for the plants to feed on, and under these conditions they will then grow to the ordinary size.

For instance, I frequently come across many specimens of the Field Scabious—which generally grows between one and three feet in height—certainly not more than two inches high and with the blossoms only half the usual size. In the pastures we do not find this dwarfing to the same extent, and many of these are rich hunting grounds, and produce several interesting, and not very common, plants.

THE DWARF PLUME THISTLE

In finding a resting place on the downs one has to be very careful sometimes in selecting a spot whereon to sit, for the Dwarf Plume Thistle (*Carduus acaulis*) has a habit of spreading its very prickly leaves so that it covers a great deal of ground. This thistle is easily distinguished by the lack of stem, its spreading rosette of very prickly, pinnate leaves, in the middle of which appears a rather large, purple flower head. All the Thistles belong to the family of Composite plants (*Compositæ*); the flower heads are a collection of florets, all of which are tubular in shape. These are succeeded in the late summer and early autumn by masses of white, feathery down. This plant is not found in the north of England; it flowers from July to September.

THE CARLINE THISTLE

The Carline Thistle (*Carlina vulgaris*) is not by any means confined to the chalk downs, although it is generally to be found growing thereon, and for this reason it is included in this section. All the Thistles bear purple florets, but this one possesses so many yellow bristles that the purple colour is not so noticeable; this characteristic will make it easy for anyone to recognise it. The whole plant is generally about six or eight inches high, but, on the downs, it is very often quite dwarfed, and not more than one or two inches in height. The lower leaves are narrow, spread flat on the ground, and covered on the under sides with white, cottony wool; the upper ones are broader

CARLINE THISTLE.

DWARF PLUME THISTLE.

and have no wool; all the leaves are spiny. The flower head itself is surrounded by brownish yellow bracts (these are also spiny) which give the whole flower a somewhat dried-up look; these

HARE BELLS.

bracts keep their form and colour long after the florets have bloomed.

The name Carlina (or Carolina) comes from the tradition that the root of *Carlina acaulis*, another member of the genus, was shown by an angel to Charlemagne as being a remedy for the plague that was devastating his army.

THE HARE BELL

One of the most graceful and delicate of plants is the Hare Bell (*Campanula rotundifolia*), a general favourite amongst our wild flowers. It is impossible to say what is the origin of the common English name; Prior considers that it is, in all probability, a corruption of some other word, perhaps Heather Bell. The name Campanula means a little bell, and comes, of course, from the shape of the flower. When the plant is seen growing, the amateur botanist may wonder why it is called the Round-leaved Campanula, since all the leaves that are to be seen are small and narrow. The explanation will be found by digging up a young plant carefully, or else by scraping away the grass which is growing around the thin, wiry stem just where it joins the ground, for then a few round or heart-shaped leaves, coming up from the roots, will be seen; these wither when the plant is in flower. The flowers secrete honey at the base, and are much sought after by insects. The hanging position of the blossoms serves to protect the honey from the rain, and the fact that the sensitive part of the stigma is turned downwards, prevents the pollen falling on to it, and so self-fertilisation is avoided. This plant is the true Bluebell of Scotland.

CLUSTERED BELL FLOWER

A near relation to the Hare Bell is the Clustered Bell flower (*Campanula glomerata*), which is to be found growing in dry pasture land. This plant sends up a stiff, erect stem, about a foot high—often dwarfed to about three or four inches—generally covered with stiffish hairs; the lower leaves are stalked, but the upper ones clasp the stem; all of them are rough and hairy. At the top of the stem is a cluster of dark blue bell-shaped flowers, but they are not pendulous as in the case of the Hare Bell. One or two flowers will also be found singly or in pairs below the terminal cluster. None of the flowers have stalks; they grow out of the stem, in the axils

of the leaves. The Nettle-Leaved Bell flower (*Campanula Trachelium*), a photograph of which is given for comparison, grows more frequently in woods, and is different in general appearance; the flowers are shortly stalked and have a more pendulous habit, although sometimes they are gathered into a terminal cluster as in *Campanula glomerata*. The leaves are coarsely toothed, and are very similar in appearance to those of the Stinging Nettle.

CLUSTERED BELL FLOWER.

NETTLE-LEAVED BELL FLOWER.

Another little dark blue flower to be found on the downs is the Field Gentian (*Gentiana campestris*), which, in these localities, appears as a small bunch of dark blue flowers and leaves with scarcely any stems. All the parts of the flower are in fours, and the mouth of the corolla is furnished with a fringe of hairs, probably to keep small insects from creeping down into the tube and stealing the honey.

YELLOW-WORT

A very striking plant, the Perfoliate Yellow-wort (*Blackstonia perfoliata*) is often to be seen growing in dry pastures, especially in chalky districts. It is a member of the Gentian family, and may readily be recognised by the fact that its leaves grow in pairs, and are so connected at their bases that the pale sea-green stem appears to be growing through the middle of one leaf, whence the name *perfoliate*. At the summit of the stem are a few bright yellow flowers, with all their parts in eights; the calyx has eight lobes or divisions; there are eight lobes to the yellow corolla, and eight stamens. Both the stems and leaves

are of a glaucous, sea-green colour, and altogether it is a plant which is so distinct from others that it should be at once recognised. Like the Dwarf Plume Thistle, this plant does not extend beyond the central and southern portions of England; it is to be found in flower from the end of June to September.

BEE ORCHIS

Never shall I forget finding the Bee Orchis (*Ophrys apifera*) for the first time. It was in a dry field, just under one of the chalk downs in the Isle of Wight, growing in great abundance, together with the Perfoliate Yellow-wort—which plant I also saw then for the first time. The family of Orchids, all the world over, produces many of the most interesting plants that are known. Their peculiar shapes, colouring and construction all tend to make them noticeable.

The stem of the Bee Orchis grows as much as eighteen inches high in a good locality, and bears a few oblong leaves near the base, and a few rather large flowers towards the summit, each one with a leafy bract. The whole of the flower bears a distinct resemblance to a big bee on the wing, the "lip" being of a rich velvety brown, very downy on the sides, and marked by paler lines and spots; the outer sepals are prominent and pale pink or greenish white. The mimicry of nearly all the Orchids appears to have the especial object of attracting certain insects and birds with a view to securing the transference of the pollen from one plant to another, but in the case of the Bee Orchis this does not seem to be the case. Self-fertilisation appears to take place in almost every instance, for the pollen is contained in pear-shaped masses, which, at the proper time, drop out and hang directly over the stigma, so that the slightest breath of air is sufficient to bring them in contact. What, then, can be the reason for this curious mimicry? One botanist has suggested that this resemblance to the bee was to prevent insects visiting the flowers, but Darwin—who devoted a special book to the various methods of orchids to secure fertilisation—believed that the mimicry served to secure an occasional cross. Neither of these explanations is very satisfactory. It is hard to imagine that the plant has taken such pains for, it must be some hundreds of years, to arrive at this stage, and has attained no special object by doing so. Is it only a freak of nature, and not an instance of mimicry at all? The name *Ophrys* comes from a Greek word signifying an eyebrow. Pliny states that a member of this genus was used in ancient times to darken the eyebrows.

LADY'S TRESSES

The Lady's Tresses (*Spiranthes autumnalis*) is another representative of the Orchid family to be found on the downs and on dry, upland pastures. It flowers somewhat late in the year, and should be looked for in September and October. Identification should not be difficult; the photograph shows well the peculiar spiral arrangement of the blossoms on the stem. The flowers are white and fragrant, and at the base of each is a leafy bract, which remains upright on one side of the stem, while the flower diverges horizontally to the other side. The broad leaves grow in a tuft at the base, and the flowering stems appear by the side; up the stem will be seen short, pointed leafy scales.

ROCK ROSE

A fairly common plant, which is to be found in summer and early autumn growing in dry pastures, especially in chalky and gravelly districts, is the Rock Rose (*Helianthemum Chamæcistus*). It possesses somewhat woody stems, which trail along the ground and send up erect flowering branches; the lower portions of the stem are smooth, frequently hairy, and of a reddish colour. The leaves grow in pairs, but are somewhat irregular and become smaller as they approach the flowers; they have short footstalks, and roll their edges backwards; the underneath is grey, from a fine coating of down. The bright yellow flowers, with rather crumpled petals, are borne in a loose raceme, the flower stalks being slightly bent downwards both before and after flowering; there are five green sepals, three of which are larger than the other two—each of these has three ribs and is nearly transparent, and concave in shape; the other two sepals are very small. These flowers, beautiful as they

BEE ORCHIS.

PERFOLIATE YELLOW-WORT.

LADY'S TRESSES.

VIPER'S BUGLOSS.

are, are of no use for picking, as they close almost immediately; anyhow, their life is a very short one, which fact has given rise to the names "Day's Eye" and "Sunflower."

VIPER'S BUGLOSS

The Viper's Bugloss (*Echium vulgare*) is another plant that is fond of chalky pastures, although it is by no means restricted to these localities. This plant is a robust relation of the Borage, and is one of the handsomest of all our wild flowers. It often grows between two and three feet high. It bears a long, one-sided, flowering spike, with flowers of a reddish purple colour when they first emerge from the pink bud; afterwards they turn a beautiful bright blue; the flowers appear in June and July. The leaves are rough and hairy, and this has given to the plant the name Bugloss, which is derived from two Greek words, signifying an ox's tongue; the Latin name, *Echium*, means a viper. The reason for this name is a little obscure; it may be that the plant was supposed to be an antidote for a snake's bite, or because the stem of the plant is speckled like a viper's skin.

H. PUREFOY FITZGERALD.

ROCK ROSE.

A WARWICKSHIRE COTTAGE.
From the Painting by A. C. Wyatt.

HOW TO KNOW THE INSECTS

By JOHN J. WARD

Author of "Life Histories of Familiar Plants," "Some Nature Biographies," etc.

IN WINTER QUARTERS

With Photographs by the Author

WITH the retreat of the sun's warmth as November draws near, our insect friends daily decrease in numbers, and the tyro who, throughout the summer months, has been diligently endeavouring to understand their curious, fascinating, and often extraordinary habits, becomes sorely puzzled as to what has become of them. That they must still be in existence is obvious, for he knows that in the following season they will appear again in their own particular environment, and carry on their activities just as if no interval had occurred.

In this concluding chapter of the present series, I propose, therefore, to consider some winter aspects of insect life, dealing more particularly with the insects already considered in their summer stages.

TWO CHRYSALIDES OF THE ORANGE-TIP BUTTERFLY.

Showing how they resemble the seed pods.

Regarding the butterflies illustrated in this work, I have previously mentioned that the Small Tortoise-shell, the Brimstone, and the Peacock spend their winter hibernating as winged butterflies (see pp. 49, 216, and 494), their frail forms enduring cold and frost until the arrival of more congenial temperatures. The Green-veined White Butterfly (see pp. 211 to 213) behaves quite differently, however, during the winter months. Just before winter the full-fed caterpillar climbs the garden wall, or a wooden fence; in the former case it usually comes to rest in the groove of the coping-stones, moulting its skin and so changing into its chrysalis stage, and there resting sheltered from rain and cold winds until better days again come. A search round the garden wall will nearly always reveal a few chrysalides of this species, and still more often those of the Small White and the Large White butterflies, which select similar places for their winter quarters. When a wooden fence is selected the chrysalides are usually found between the angles of the palings.

The Orange-Tip Butterfly, in its caterpillar stage, as we have previously seen (p. 47), largely resembles the seed pods on which it feeds, and, probably because this mimicry proves so effectual, the insect finds it profitable to carry this same device into its chrysalis stage. On this page two chrysalides of this insect are shown attached amongst the seed pods, and the photograph will make clear how closely they resemble their surroundings. At first they are green, but as the seed pods become brown the chrysalides also assume that colour. In this way they retain the closest resemblance to the plant, and in spite of the heavy snows and rains and

freezing temperatures, in early May a delicate butterfly clothed in white and mottled-green (or, if a male insect, also

A FEMALE CHALK-HILL BLUE BUTTERFLY.

in bright orange hues), bursts forth to greet the early sunlight.

Both the White Admiral and the Silver-washed Fritillary butterflies (previously considered, pp. 127 and 255) spend the winter period as tiny caterpillars hidden amongst the leaves of their food plants. The same may be said of the Chalk-Hill Blue Butterfly (*Lycæna corydon*), illustrated on this page; the photograph shows the female insect.

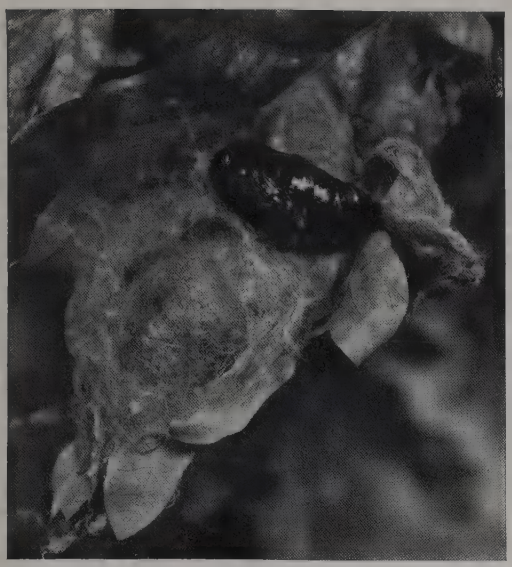
The elegant butterflies known as the Blues are always attractive, though they are small in size when compared with those species I have considered earlier. In the males the wings are generally bright blue above, but in the females they are usually brown tinged with metallic blues or purples. Sometimes the sexes are so different that they would hardly be taken for the same species. There are several genera of these insects, and experts are often puzzled to make quite sure of the identity of the various species. The large size and the pale silvery-blue of the upper side of the wings, which are also edged with black, will usually distinguish the male Chalk-Hill Blue as it flies in the chalk districts; from this latter characteristic it derives its popular name.

Turning to moths, we may first consider the Black Arches (illustrated p. 214), for this insect winters in a remarkable manner. In July the female insect deposits her numerous eggs in suitable situations amongst the crevices of the bark, and about the newly formed buds. In these situations the eggs remain for the rest of the summer and throughout the autumn, winter and a part of spring —until early in April of the following year. The curious feature is, however, that the little caterpillar makes its appearance within the egg late in autumn; its

"WOOLLY BEARS" AS THEY APPEAR JUST BEFORE WINTER.

variously coloured body (see illustration p. 130) may be seen coiled up through the transparent shell, though it does not break the shell to emerge until April.

Such is an unusual method of hiber-



COCOON AND CHRYSALIS OF THE PALE TUSSOCK MOTH.

nating amongst moths; more often the caterpillars emerge from the eggs and feed for a little time during the autumn, then hide among leaves for the winter. This method is adopted by the larva of the Drinker Moth (p. 45), and also by the "woolly bear." On page 630 some of the latter caterpillars are shown as they appear just before winter, and while on their favourite food plant, the white dead-nettle; the full-grown larvæ were illustrated on page 48. The Narrow-bordered Five-Spot Burnet Moth (illustrated p. 258) behaves very similarly. The quaint stick-like caterpillars of the Swallow-tail Moth (illustrated p. 50) also spend the winter as larvæ, but they are usually about half grown before winter commences, hiding away in sheltered corners amongst the bark and branches, and trusting for protection to their close simulation of their surroundings.

The Cinnabar Moth, whose larvæ were illustrated on page 259, is during winter a brown chrysalis resting amongst the grass near the surface of the ground. The Buff-tip Moth (shown p. 215) may be found also in similar situations, but generally amongst fallen leaves; as its chrysalis is quite bare, it is often exposed when wind or other agencies have disturbed the leaves. The chrysalides are especially abundant round the base of elm trees.

Then there is the Pale Tussock Moth, whose emergence from the chrysalis was illustrated on page 73. On this page a still earlier stage is shown, as the insect appeared before winter. Late in September the caterpillar attaches together one or two oak leaves, and then proceeds to denude itself of the tufts of hairs that clothe its body. With the hairs it weaves a kind of warm and thick felt, which serves to protect it both from cold and wet and also from its enemies when it becomes a chrysalis. In the illustration I have removed the chrysalis from the cocoon to exhibit its form; the chrysalis itself is slightly hairy. So in the chrysalis stage, the moth waits until

BUFF ERMINE MOTH.
With cocoons and chrysalides.

about early May, when it emerges from its chrysalis and cocoon to develop its wings as previously explained.

Another pretty moth with similar habits, and one which readers of THE NATURE BOOK may have frequently seen during the summer months, is that illustrated on page 631, the Buff Ermine Moth (*Spilosoma lubricipeda*); an insect with creamy yellow wings spotted with black. As this country the insect is generally scarce, but occasionally, for some peculiar reason, it occurs in comparative plenty in various districts, and perhaps it is more common now than formerly. It derives its popular name from the curious skull-like marking on the back of the thorax, which shows well in the illustration. Another remarkable feature of the moth is that, when captured, it will often make a peculiar squeaking noise; this peculiarity, together with the strange marking on the thorax, has given rise to much superstition in the rustic mind with regard to this insect. I need scarcely add, however, that it is quite harmless.

DEATH'S-HEAD HAWK-MOTH.
The largest British moth.

autumn advances the caterpillar of this moth becomes full-fed, and with the hairs from its body forms a cloth-like covering that envelops its chrysalis. Some of the chrysalides are shown in the upper part of the illustration; they are usually found near the surface of the ground.

I have previously described how the Lime Hawk-Moth passes the winter period beneath the ground (p. 74), and likewise the Poplar Hawk (p. 492). The Privet Hawk (p. 213) behaves in an almost identical manner, and to these we may now add the Death's-head Hawk-Moth (*Acherontia atropos*). This is the largest British moth; indeed it is the largest lepidopterous insect found in Europe with one exception — the Great Peacock Moth (*Saturnia pavonia-major*). The Death's-head will sometimes measure a little more than five inches in expanse of wings. In

On page 633 the same insect is shown in its winter aspect some three or four inches below the surface of the earth. These large chrysalides are often turned up in potato fields, as the caterpillar generally feeds on that plant.

Regarding the aquatic insects I have illustrated in this work, the Pond-Skater's winter devices I have already referred to (p. 50). The Diving Beetles, illustrated on page 261, may spend the winter, as the summer, in the pond, although they are less active, and do not use their wings during cold weather, preferring the muddy bottom of the pond, where it is warmer

THE DEATH'S-HEAD HAWK-MOTH DURING WINTER.

than in the atmosphere. Otherwise they may pass the winter in the pupal or chrysalis stage, burrowing amongst the moist mud and sand on the banks of the pond, but not actually in the water. Furthermore, if the larva has not completed its development on winter's approach, the insect continues in that undeveloped state during the cold season, remaining more or less dormant at the bottom of the pond.

The graceful Dragon-fly (illustrated p. 131) likewise spends its winter as a larva in the muddy depths of the pool, the nymph or pupa leaving the water in early summer and completing its final development to the winged stage on the stems of the water weeds.

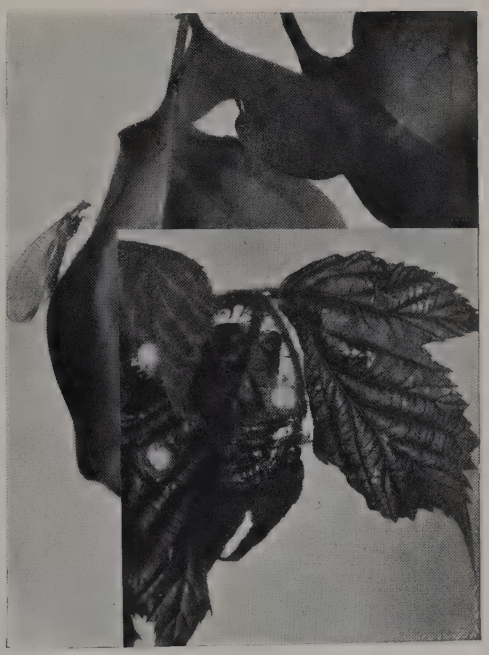
The Stag Beetle (p. 260) in winter is a larva or grub hidden within the trunk of the tree on which it is working destruction, and on which it sometimes feeds for four years. Its winged stage is probably confined to the summer season. Likewise with the Cockchafer Beetles (p. 216), which spend two or three years in their larval state, but in this case carry on their destructive work beneath the soil, feeding on the roots of growing plants; the final winter is spent in the pupa stage also below the soil, the perfect beetle appearing in the summer season.

The Giant Sirex, or "Wood Wasp" (p. 491), in its winter habits resembles the Stag Beetle, living for several years in its larval stage in the heart of a tree.

Regarding the Frog-Hopper, or "Cuckoo Spit" (p. 259), I am quite unable to say how this insect passes the winter. The complete life-history of an English species has not to my knowledge been yet investigated. Here, therefore, is an opportunity for some reader of THE NATURE BOOK to attain scientific fame in a novel field.

From what I have written here, it is very obvious that the various insects have quite different methods of solving the great winter problem with which, in this country, they have necessarily to contend. Therefore, the only way in which to make sure of an insect's winter quarters is by close observation of its movements as the cold season approaches.

Finally we may consider the beautiful Lace-wing Fly (*Chrysopa vulgaris*) shown below. The winter state of this insect was for some long time a puzzle that I was unable to solve. Entomological works seemed uniformly mute upon the point, excepting one work which stated clearly that the insect passed the winter in the larval stage. However, late in the autumn of 1905 I met with some larvæ



THE LACE-WING FLY.
Below are shown three cocoons.

of these insects, and these I kept under observation. Before winter they formed some curious, almost circular cocoons, covered with a kind of white silk. Some of these are shown in the illustration attached to bramble leaves just as they were formed by the insects. The cocoons remained until June 8th, 1906, when one was opened from within, a circular cap being cut off from the top and pushed open, and so, like a Jack-in-the-box, the insect emerged. This was clear proof, therefore, that the winter stage was that of the pupa or chrysalis.

The Lace-wing Fly is a surprisingly large insect to come from so small a cocoon. Probably the readers of THE NATURE BOOK have frequently observed this beautiful insect with its gauzy, iridescent wings and dreamy flight, its emerald green body, its jewel-like eyes; but if its charming colours have tempted them to capture and touch the insect they may have learnt a lesson. With all its delicate beauty this pretty fly is the veritable skunk amongst British insects. It can produce a smell so vile that if your fingers, and especially your gloves, should come in contact with it, you are assured of a most uncomfortable time, for the smell is often more than soap and water will remove. This foul odour is, doubtless, the insect's protection against its foes, but such delicacy of form and colour combined with so repulsive a characteristic is surely one of Nature's most incongruous performances.

JOHN J. WARD.

HOW TO KNOW THE TREES GROWING IN BRITAIN

With Notes, descriptive and photographic, for their Identification in all Seasons of the Year

By HENRY IRVING

THE APPLE AND PEAR GROUP—II

THE WILD SERVICE

THIS is a tree of very local occurrence, and chiefly in the southern counties. The grey bark is decidedly scaly. The buds are nearly round, shining, green in colour. There are narrow brown margins to the scales. The leaves are cut into from five to seven pointed divisions, each of which is supported by a strong secondary rib. The venation at the base recalls that of the Plane. The leaf margins have saw-like teeth. The flowers are more loosely branched than those of the White Beam. The fruit is oval, brown in colour, with lighter spottings.

This is one of the earliest of our trees to assume its autumn tints, showing golden and brown shades among the green, often before the summer is gone.

A tree, usually distinguished as the True Service, is occasionally to be met with in park or garden. It bears less resemblance to the Wild Service than to the Rowan or Mountain Ash, for which it might easily be mistaken at first sight, having the same habit and similar foliage. A closer examination will at once reveal decided differences. The bark is like that of the Wild Service, rough and scaly from the first. The twigs are smooth and shiny, the buds are green, smooth, and slightly sticky. They stand out from the twig. The leaves, so like those of the Rowan, have broader leaflets, and these have marginal teeth near the tip only. The flowers, of a creamy white, are larger than those of the Hawthorn. The fruits, clustered two or more on a single main

stalk, may be round or pear-shaped. They are green, or reddish, with brown spots; are almost as large as crab-apples, and have a like depression at the base.

THE ROWAN, OR MOUNTAIN ASH

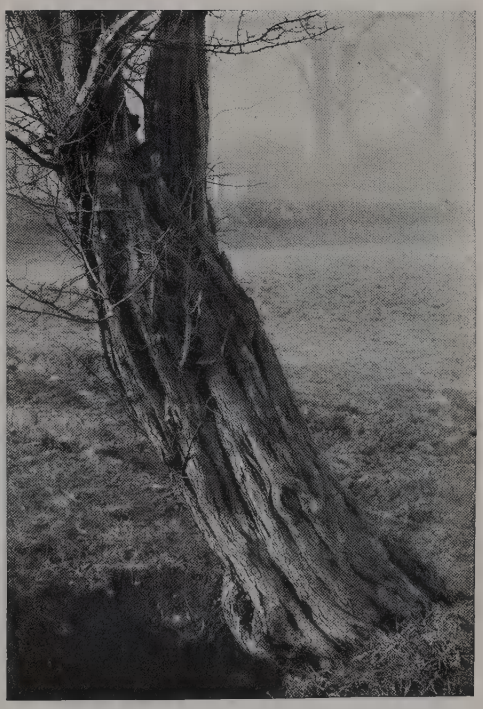
We have here one of the hardiest and most adaptable of our trees. Its natural preference is for the wild moorland, but it penetrates into the fastnesses of the mountains, and is found in Scotland at an elevation of 2,600 feet above sea level.

TRUNK AND BARK OF WILD SERVICE.

Yet it can fraternise with the Alder in the water meadows, and flourishes in thousands of suburban gardens. It is seen at its best, at all seasons, in the neighbourhood of the Pines, or upstanding with the Birches among the bracken and heather. It is never more than a small tree, and its branches ascend in rather loose order. The moderate quantity of feathery foliage carried by the branches give it an easy grace, an airy lightness.

The bark, which

TRUNK AND BARK OF ROWAN.



TRUNK AND BARK OF HAWTHORN.

is grey in colour, is smooth at first, and marked with transverse lines as that of the Wild Cherry. Later it becomes thickened and furrowed. The twigs are short, slightly velvety, grey to brown. The buds are large, pointed, pressed up against the twig, distinctly velvety, purplish black or grey. Should doubt arise with respect to this tree, it may be distinguished from the Ash by the spiral arrangement of its buds. The leaf-scar is long and narrow, showing five leaf-traces.

LEAVES OF (1) WILD SERVICE, (2) HAWTHORN, (3) WILD APPLE.

The leaves are compound like those of the Ash. It is from this fact that this tree has acquired the somewhat misleading name of Mountain Ash. Rowan and Ash are not related. Each leaf consists of from five to nine pairs of leaflets, with a terminal one. The margins of these are toothed like a saw. The flowers are Hawthorn-like, but of smaller size individually, and borne as previously indicated. The fruit clusters are brilliant with a colour all their own, a vermilion shade of red, which gives to this tree from late summer onwards, so long as the birds will permit, its most distinctive character. Blackbirds and thrushes swallow down the fruit in wholesale fashion, so ensuring for its contained seeds an abundant and wide dispersal.

THE HAWTHORN, OR WHITE THORN

On every side is the Hawthorn, in the season of its blossoming, extending along the borders of the fields like rolling masses of sea-foam; scattered over the commons and up the hill slopes in mounds and wreaths; possessing all the land with the wonder, all the air with the fragrance, of the "May."

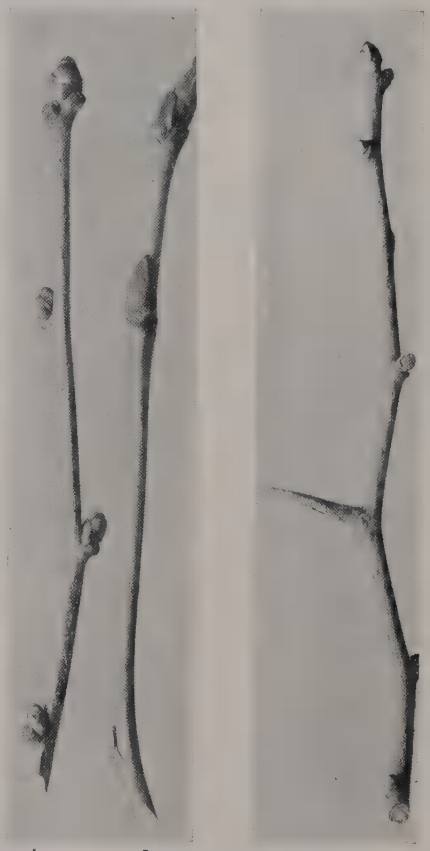
Growing as a small tree it presents a rounded crown, with great crowd and entanglement of branch and twig, which, through the summer, supports close density of shadowing foliage, beloved of many wild birds for the hiding of their nests. The dull grey bark of its often fluted main stem is roughened into closely set furrows. The twigs, which are dull brown, or silvery grey, vary from long shoots with buds and leaves apart, to short shoots with buds placed closely, and leaves gathered into tufts. These short shoots end in sharp thorns. Thorns are

SCATTERED MASSES AND MOUNDS OF "MAY."

HAWTHORN IN BLOOM.

also found on the long shoots, rising out of these at the points of junction with the leaf-stalks.

The name Hawthorn, which is simply



1 2 3

TWIGS OF (1) WILD SERVICE, (2) ROWAN, (3) HAWTHORN.

Hedge-thorn, denotes the fact that this, of all growths, has come most into use in the formation of live fences. Easily propagated by cuttings, well enduring the shears, dense with crowded twigs and thorns, it speedily becomes an impenetrable barrier.

The leaves are extremely variable. They show from three to five, or seven, main divisions, some of which are cut down nearly to the midrib. At the base of the leaf-stalks on the long shoots are leaf-like expansions (stipules), which here have the appearance and serve the purpose of supplementary foliage. In autumn the leaf colouring shows great variation and range—yellow, red, bronze, and purple.

The flowers are generally white, as those of the Blackthorn, but their whiteness is softened by the fresh greenery of the associated foliage, and by the

LEAVES OF ROWAN.

many pink or purplish heads of the enclosed stamens. The brightly-coloured "haw" is apple-like in outward appearance, but it differs from the produce of other trees in this group, in that it is in reality a stone fruit.

HENRY IRVING.

CONCERNING THUNDERSTORMS—II

By WILLIAM J. S. LOCKYER, M.A., Ph.D., F.R.A.S.

ALTHOUGH I am interested both in ballooning and thunderstorms, I prefer not to study them simultaneously, and would advise others to do the same. Thunderstorms spoil all the pleasure and fascination of ballooning, because when one wishes to take an aerial trip the conditions are best when the wind is steady in one direction. This is not the case when a thunderstorm is in the neighbourhood. There is either no wind or it is liable to change its direction any moment, and flashes of lightning playing around are not desirable companions when one is supported by an envelope full of inflammable gas! Further, in the front of a thunderstorm there are up currents which are far from desirable when one is in such a craft, and it was my fate on the occasion of my first balloon trip to be in such a current. This occurred on June 29, 1907, when a passenger in one of the balloons competing in an Aero Club long distance race.

A violent thunderstorm was nearly over us as we ascended, and we expected to attain a certain altitude in accordance with our "lift." But this was by no means the case actually, for we found ourselves in a current directed from the earth, which not only sent us up an extra 2,000 feet, but was strong enough, before the balloon responded to the ascending current, to blow upwards into the basket of the balloon a large square of calico which was suspended from the side of the basket. At about 5,000 feet we somehow became free of this current, and naturally began to fall with considerable rapidity, which was only checked by the bountiful discharge of ballast.

Now perhaps the most important feature of a thunderstorm is the electrical phenomena connected with it, and naturally these are best seen when the storms occur after the sun has set. Lightning flashes have been observed by man ever since he walked on the earth, but it was not till Franklin's time, in 1752, that we were taught that lightning was identical with the electricity that can be artificially produced. Franklin proved this by tapping the electricity under a thunder-cloud by means of a kite, using the cord of the kite as a conductor to bring the electricity to earth.

A lightning flash may be looked upon as the result of a great electrical disturbance between masses of vapour condensed in our atmosphere in the form of clouds, that part of the earth's surface which lies immediately below these masses, and the intervening air space.

Perhaps the most difficult question to answer is "How is the electricity produced?" Electricity is undoubtedly formed in our atmosphere, but whether it is the result of condensation of water vapour, or caused by evaporation, or by wind, or any other means, it is difficult to say. Its origin is generally attributed to condensation in the following manner. Electricity, it must be first understood, only resides on the surface of a body. Each minute particle of a cloud has a small electric charge distributed over its surface. When condensation takes place these particles coalesce and form raindrops. The surface of *one raindrop* being less than the combined surfaces of all those of the particles of which it now forms part, there must be more electricity per unit area on the raindrop than there was on each particle. The consequence is that the electrical potential of the raindrops increases with condensation.

The greater, therefore, the raindrops, the more heavily laden becomes the cloud and the darker it appears.

With this ever increasing store of electric energy on the cloud it is certain that a limit must soon be reached, and

an outlet must be found for it in some way or other. Now air, unlike copper or silver, or metals of any kind, is a very bad conductor of electricity, and since the cloud is surrounded on all sides by this medium, this electric energy finds no ready means of escape. Sometimes a heavy shower of rain is sufficient to carry off the electricity and reduce the potential of the cloud to that of the earth.

With very rapid accumulation of electricity, however, this safety valve may not be sufficiently quick acting. When this occurs the potential of the cloud may become greater than that of the earth below it or greater than that of a neighbouring cloud, with the result that a disruptive discharge through the intervening air takes place, and we have the phenomenon of a flash of lightning.

The discharge is called "disruptive" because the resistance of the air being so great, much of the electric energy of the flash is transformed into heat, and the air particles are put into such violent vibration that they become luminous.

Although the above reason has been given to explain the origin of the electrical condition in thunderstorms, the reader must still remember that no final decision has been arrived at. Whatever may be the source from which the electric discharge obtains its energy, there is no doubt about the enormous power pent up in such violent flashes. Thunder, the direct result of such discharges, makes one familiar with the forces at work.

So highly heated becomes the column of air through which the discharge makes its way that the air, in trying to accommodate itself to the rapid change of temperature, expands with all speed. This expansion and subsequent contraction—the air particles rushing in to fill the partial vacuum caused by the former—give rise to a series of air waves, producing sounds, throughout the entire length of the column. These waves are as much emitted by the main stream of the discharge as they are by the branches or ramifications of the flash, so that the sources of the different noises are at a great number of different distances from the observer. If the flash be a short one, and the observer near it, the sound will be almost simultaneous, and this is known as a thunderclap. It is like a sharp rattling explosion, accompanied sometimes by a hissing noise. This hissing noise seems to be directly connected with the lightning flash, and is familiar to one who is acquainted with sparks made in the laboratory. It is therefore correctly referred to in the following quotation from the "Ingoldsby Legends":

> "It was in such an hour as this
> On such a wild and wintry night
> The forkéd lightning seemed to hiss."

If, on the other hand, the flash is of considerable length and has many branches, the sound waves, emanating simultaneously from the various parts of the discharge, have distances of various lengths to travel, and so do not reach the ear at the same moment. The reason for this is that while light travels almost instantaneously, namely, 186,000 *miles* per second, sound only covers about 1,100 *feet* in the same time. The greater the distance the flash is away the longer is the time interval between the discharge and the hearing of the thunder.

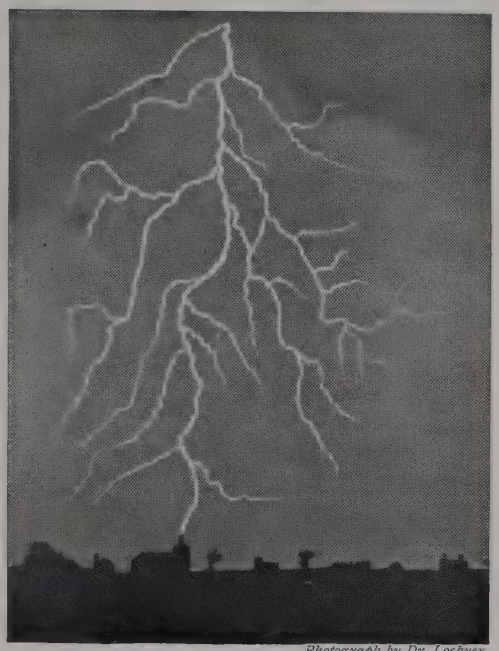
The noise impressed on the ear by distant flashes is of a rolling or rumbling nature, and is usually referred to as a thunder-peal. Although the lengthening of the duration of a thunderclap may be to a great extent caused by echoes from the earth's surface, there seems reason to believe that a considerable portion of it may be due to the successive arrivals of the air waves from the various parts of the numerous branches of the main discharge.

It is sometimes stated that the rolling is due to the noises being reflected from the clouds, but in the face of the Rev. J. M. Bacon's experiments this cannot be claimed. Mr. Bacon made his experiments by exploding cartridges from underneath the car of his balloon, and although he always heard the echo from the earth, he recorded no instance when they were returned by clouds. His observations are so interesting that I quote one of them, which is of special importance here:

"First, when about 3,000 ft. above the cloud layer, we lowered a cartridge, and, stop watch in hand, listened carefully for the result. It exactly repeated our former experience. Absolute silence ensued, until

full time had elapsed for the earth to reply, when the same peal of thunder rose up which we were already accustomed to. And this thunder was in no way diminished by the intervening depth of dense cloud, which the waves of sound would have to traverse. . . . The result was always the same, and proved first throughout this afternoon there was never even the suspicion of an echo from the cloud or sky."

Leaving the subject of thunder, attention may now be directed to perhaps the most interesting feature of thunderstorms, namely, lightning discharges, which, as I have previously indicated, are nothing but ordinary electric sparks on a gigantic scale. Most of us are familiar with their general appearance. Their form was, and even now is, sometimes described as "zigzag," but this is quite erroneous, as many of my readers are aware. In a large experience of watching flashes closely, I have never observed a single instance of such a form, and after an examination of several hundred photographs I have never seen one that exhibited this shape.



Photograph by Dr. Lockyer.

A TRACING OF THE RIVER AMAZON AND ITS TRIBUTARIES TO REPRESENT A FLASH OF LIGHTNING WITH RAMIFICATIONS.

Flashes of lightning, especially when they are accompanied by branches or ramifications, have very much the appearance of a river and its tributaries, as shown on maps. To illustrate what I mean I have prepared the accompanying illustration. Now this photograph is not a flash of lightning taken with a camera, but a composite picture made up dexterously by means of a piece of cut paper to represent a landscape, the use of cotton wool to give cloud effect, and last, but not least, the tracing of the river Amazon and its tributaries from a school atlas, to represent the lightning flash! I leave it to the reader to decide whether or not the comparison is a good one, for actual photographs of lightning flashes are reproduced further on, and special attention is called to the flash on page 643.

Curiously enough it is only, roughly speaking, within the last twenty-five or thirty years that the study of lightning has been made with the photographic camera. The application of the sensitive plate has, however, cleared up many old fallacies, while at the same time it has taught us many things concerning lightning flashes which were unknown before.

With such fleeting objects as these discharges the eye is very apt to be deceived, and it is just in such instances that the camera becomes invaluable.

In fact, the enjoyment of a thunderstorm is considerably enhanced by making use of a camera, or several if one is fortunate to have more than one. One is able then to supplement camera with eye work, and obtain very useful results.

Space does not permit me to refer, even briefly, to the many points of interest that this instrument has opened up, but some of the more important of them may be mentioned.

In the first place, the general form of the lightning flash was accurately recorded, showing that the flash was usually of a wavy (not zigzag) nature, and that sometimes it had branches and sometimes none at all. Several specimens of these types will be seen in the accompanying

LIGHTNING FLASHES TAKEN IN AUGUST, 1892, AT SYDNEY, AUSTRALIA, BY THE LATE MR. H. C. RUSSELL.

A SERIES OF LIGHTNING FLASHES PROCEEDING FROM A CLOUD TO THE EARTH
Illustrating the river-like form of the discharges and the continuity of the streaks representing several flashes. Photographed at Vereeniging, Transvaal, by Mr. T. N. Leslie.

illustration. This beautiful photograph, showing a great number of brilliant flashes literally pouring down from one portion of a cloud, was taken at Vereeniging, in the Transvaal, by Mr. T. N. Leslie.

Another fine example illustrating several flashes scattered over a wider area is that shown on page 642. This photograph was taken during a storm which passed over Sydney Harbour, in Australia, in August, 1892. It was taken by the late Mr. H. C. Russell, and is one of many which he succeeded in securing.

It may be mentioned here that the branches in lightning flashes are, so to speak, leaks in the main stream ; all the electricity is not able to pass quickly enough through the main channel, and so has to find other outlets along lines of least resistance. An approximate simile may be found in a leaky garden hose pipe when the tap is turned full on. The pressure is so great that the water cannot pass through the pipe sufficiently quick, so squirts out at those parts of the pipe where it can escape easiest. In the case of lightning discharges, even the branches divide and subdivide again, and the current in these cases becomes so dissipated that the earth is often never reached by any of them.

A good instance of this is seen in the photograph here reproduced, where the branches on both the right and left hand sides split up into several minor branches and vanish in the air. This interesting photograph was secured by Mr. Paul Georgi at Radebeul, near Dresden.

In all these photographs of lightning which show branches the flashes were discharges from cloud to earth. This direction of the electric current is established by noting the direction in which the branches leave the main stream. Thus, if the reader looks at the above picture, it will be seen that they point downwards, and thus indicate a downward discharge, or, in other words, a cloud-to-earth flash. The majority of flashes which have been photographed all indicate such downward discharges, but a few cases have been met with where the current flowed in the opposite direction. Many observers of lightning have stated that they have seen such flashes, and were certain that the direction of the discharge was upwards ; but their cases were generally looked upon as *non proven*, not only because no photographs displayed this peculiarity, but because it was considered impossible for the eye to differentiate between an upward or downward discharge.

A RAMIFIED FLASH

Showing that some branches never reach the ground in consequence of the dissipation of the electricity. Taken at Radebeul, near Dresden, by Mr. Paul Ceorgi.

Tennyson was evidently conversant with the notion that lightning discharges sometimes were directed from the earth to the sky, for in *Becket* he wrote :

" Ah, Thomas,
That lightnings that we think are only Heaven's
Flash sometimes out of earth against the sky."

That earth-to-cloud flashes do occur is now, in my opinion, beyond doubt, and the best example which has been photographed is that which was secured by Monsieur G. Mesmer, at Paris, on July 31, 1904. This photograph is reproduced on page 644. Unfortunately the flash was not

Photograph by M. G. Mesmer.

A LIGHTNING FLASH FROM THE EIFFEL TOWER TO A CLOUD, PARIS, JULY 31, 1904.

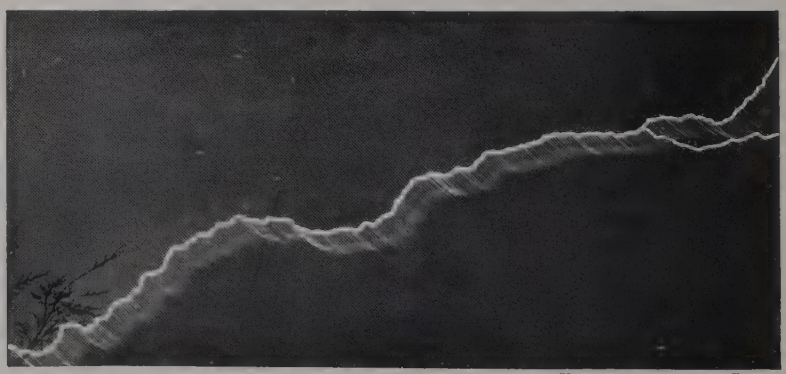
sufficiently brilliant to render the landscape very visible, so that it is impossible to make a reproduction which will show both flash and landscape at once. In order to indicate the landscape M. Mesmer took a photograph of it the next day, using the same camera and pointing it in the same direction. This photograph is placed beneath in the accompanying figure. The flash actually left the Eiffel Tower, and, it will be noticed, split up into two portions and disappeared in the cloud.

There are two other points of interest attached to lightning flashes which the application of the photographic method has cleared up completely.

Many good observers have published at different times accounts of lightning flashes which they described as " beaded," or " chapleted," or presented the appearance of a string of pearls. So well did all accounts agree with each other, that authorities were led to believe that a peculiar form of lightning flash was in question. There was, however, an element of disagreement between some of the descriptions, because one observer would state that he saw a flash which broke up into a series of points or beads, and another that he saw a series of beads alone.

Now the real origin of this " beaded " lightning, as it has been called, is this. We all now know that although a single flash of lightning is instantaneous, yet the discharge is so powerful that it heats up the channel of air through which it passes almost instantaneously to incandescence. Further, this column of air is not a straight vertical channel from the cloud to the earth, but very wavy, both in the line of sight of the observer and at right angles to it.

Now, when the lightning discharge is over, this air column cannot cool very quickly, and consequently it remains visible for several fractions of a second. Owing to the wavy nature of the column some portions of the channel will appear



Photograph by M. Emile Touchet.

TRAIL OF A LIGHTNING FLASH ON A PHOTOGRAPHIC PLATE DUE TO THE INCANDESCENCE OF THE AIR.

Camera moved by hand. April 12, 1904, 9.40 p.m. Paris.

brighter than others, namely, those where the waviness is in the line of sight. In this way, what was in the first instance a single streak of lightning appears a fraction of a second later a string of luminous points.

The reader may question the statement as to the column of air remaining luminous, but this fact has been proved over and over again, and is very easy indeed to show. All one has to do is simply to point the camera in the direction in which it is considered a flash will appear, and keep on moving the camera to the right and left, pendulum fashion. As it is known that a flash is instantaneous the movement of the camera will have no effect on its image on the photographic plate. If, however, the air channel remains for a brief moment luminous, then it will not only leave a trail but the different portions of it will indicate various degrees of intensity.

Such a method as has been above described was used to secure the photograph shown in the illustration on page 644, and it will be noticed that, not only is there a very distinct trail left by the incandescent air, but there are considerable differences of brightness at the more curvy parts of the flash. The photograph was taken by M. Emile Touchet, at Paris, on April 12, 1904.

The photographic plate used in this way thus tells us that "beaded" lightning is only an ordinary flash of lightning after all.

The next and last point to which attention may be called is an astonishing fact that the camera has revealed to us.

It has sometimes been remarked that lightning discharges were not instantaneous, or that they appeared to quiver, flicker, or vibrate, or that they appeared stationary or persisted for some seconds. Such observations, made by various observers living in different lands, evidently indicate that there *was* something peculiar about the discharges they saw, otherwise they would not have drawn attention to them.

Photograph by Alex. Larsen.

A MULTIPLE LIGHTNING FLASH.

Photographed with a revolving camera, showing the numerous components involved. Notice the parallelism of all the discharges.

It has been already mentioned that a single flash of lightning is instantaneous, or, as has been stated by the best authorities, it occupies at the most $\frac{1}{100000}$ of a second. Such a flash, if it did flicker, could not be seen to do so, as the interval of time is too short for such an observation to be made. Single flashes are therefore incapable of explaining the peculiarity noticed. What about double or triple

flashes following the same track ? Would not these, with intervals of time amounting to, say, a tenth of a second between each flash, appear to flicker ? Yes, certainly ; but do such multiple flashes occur ?

The astonishing fact which the moving camera has revealed to us is that single flashes are the exception in Nature, and multiple flashes the rule ! Further, it seems that the faster the camera is moved and the more sensitive the plate employed, the greater is the number of component discharges that can be photographed, although they all appear to the eye as one flash. To show the manifold discharges which can be photographed in a flash which appeared as a single flash the illustration on page 645 is given. This most interesting photograph was secured by Mr. Alex. Larsen at Chicago, who mounted his camera on a whirling table. The main features to which attention should be drawn are the parallelism of all the flashes, showing that they all followed the same track ; the different intensities between the individual discharges ; and finally the great number of flashes involved.

After looking at such a photograph one can quite understand that a lightning flash can be seen to flicker if it is made up of many individual discharges of different intensity, as the photograph indicates.

There are many other points of interest which both the eye and the camera have revealed that cannot be alluded to here. It is hoped, nevertheless, that sufficient has been stated to whet the appetite of the reader, and that he or she, as the case may be, will not in future look upon thunderstorms with the awe which has given rise to the saying : "When it thunders, the thief becomes honest."

When thunderstorms occur during the day-time the cloud and colour effects are the chief source of attraction, and the advent of colour photography will soon render it possible to record, in addition to the forms, the weird colours which are often seen on the approach of such storms. During the night the observer can revel in the delights of recording the many and interesting peculiarities of the brilliant flashes. A thunderstorm can thus be rendered a source of enjoyment whenever it occurs. Those fully prepared and armed with cameras can record the wild doings, as recommended in one of Tennyson's earlier poems :

" . . . . Then from a throne
Mounted in heaven will shoot into the dark
Arrows of lightning. I will stand and mark."

W. J. S. LOCKYER.

HOW TO KNOW THE WILD ANIMALS

By DOUGLAS ENGLISH, B.A., F.R.P.S.

Author of "Wee Tim'rous Beasties," "Beasties Courageous," etc.

THE SQUIRREL

With Photographs by the Author

AGES ago, one may fancy, a certain woolly Marmot waxed fat and kicked. He developed, indeed, such petulance and devilry that he must needs climb a rock, and thence fling whistled insults at his companions. His descendants developed not only tempers but tails, and in due course became the race of Squirrels.

It is a race which is almost cosmopolitan in range (Australia and Madagascar alone are Squirrel-less), and which attains its highest distinction, so far as size and colour are concerned, in the Tropics.

Our own Red Squirrel, our "lytill sqerell, full of besynese"—I am entertained to find that the latter quality has

SOME TYPICAL ATTITUDES OF SQUIRRELS.

been translated into American as "full of business" *—displays excellently the long sinuous brush, the wonderfully fashioned feet, and the abundant *vibrissæ*, or "sense-hairs," which characterise the group. His coloration varies much with the time of year, tending to rufous in the summer and to grey-brown in the winter. The presence of long ear-tufts and of a full brown-yellow tail in the latter season adds considerably to his beauty, but he never, I think, in this country displays the extraordinarily rich orange tint which characterises his continental cousins. Indeed, compared with a stout Teuton Squirrel, our British representative appears somewhat patchy and washed out, and in winter the grey on him is not comparable in warmth of tone with the "miniver" of the North European variety.

A SQUIRREL IN SUMMER PELAGE.
The absence of ear-tufts and the coarseness of the fur should be noticed.

So far as I have been able to determine by inquiry, all true Squirrels are short-tempered. It is fortunate that Nature has limited their size, for, were the dimensions of our British Squirrel twice as great as they are, this country could hardly hold him and man together.

His size being what it is (length all over about eighteen inches), and his fighting weight something under a pound, we can afford to view his outbursts with equanimity, and even derive some entertainment from the vehemence with which he rattles at humanity. His shoulders on these occasions twitch with temper. He stamps with his fore feet, he stamps with his hind feet. His insult is a spitsome cough, his curse a chromatic howl. Both are unprintable, yet Millais makes a spirited effort at the latter. He calls it "Ski-wow-wow-wow!" "Kwitt, Kwitt" (in German) is the nearest approach to the former which I have read. The difficulty of transcribing non-human sounds is due to their deficiency in consonants. Yet ornithologists rush in boldly enough. To them "A-little-bit-of-bread-and-*no*-cheese" suggests the Yellowhammer.

* Ingersoll's "Life of Mammals," p. 442.

It is fear of humanity alone which restrains the Squirrel from charging. If looks and ejaculations, let alone double-barrelled stamps, could kill, his morning round would be strewn with corpses. I say "morning" round advisedly, for the Squirrel breakfasts betimes, and it is the early risers who see most of him. More than once just before dawn I have seen Squirrels to all appearance sound asleep in the fork of a tree, or even some way out on a bough (they will weld themselves to a bough to avoid observation, but in this case their attitude is quite a different one). More than once I have visited captive squirrels in the darkness, and found them sleeping outside their nests in the most extraordinary positions. I have known them, for instance, to hang head downwards from a branch, and to sleep suspended by their hind feet or even by one hind foot alone.

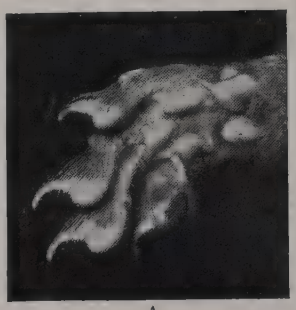
A Squirrel's nest is, I fancy, in its origin a shelter against rain and wind. I have never seen Squirrels building at large, but I have watched them construct their nests in a spacious outdoor enclosure, and as the material provided for them was "natural," I think I am justified in supposing that I have witnessed their "natural" method.

To commence with, they collect a quantity of substantial twigs, carry them in their mouths to the site selected, and build them up, layer after layer, with a mixture of moss, leaves and so forth, until they have raised a pile about a foot high. They then twist this, with their hands and feet, and an occasional pull with their teeth, into a rough hollow cylinder, which they line with more moss and leaves, fashioning an inner sphere of the latter by rolling themselves round inside it. The roofing is accomplished from within, the twigs which form the sides of the nest being tugged into suitable positions. A bolt hole, sometimes two bolt holes are left, but these are not necessarily permanent, and it is considered by some observers that their outlook is determined by the prevailing wind. If this be the case the completed structure is wind-proof and water-proof, both of which conditions are essential to the comfort of the mature Squirrel, and to the life of the immature. The breeding nest is usually about twenty feet above ground level, a depression in a hollowed fork, which is practically invisible from below, forming the most usual site. Frequently, however, a bird's nest is adapted, and Squirrels' nests have often been found at quite a low elevation.

I have mentioned that a Squirrel breakfasts betimes, but it is the exception rather than the rule that he should breakfast aloft. Even when, as is by no means always the case, he is feeding on arboreal products, he is as likely as not to come to earth with his meal in his mouth. Once he has secured his nut or fir-cone, or whatever it may be (it is a pretty sight to see him manœuvre to get a big one, for he is as "nippy" as a tomtit, and can hang by a hair), he makes for the trunk and descends full tilt. Almost invariably he pauses before he reaches the ground and looks this way and that with his prize sticking out of his mouth. Then, if all be well, he drops to earth, and bounds off, his tail rippling behind him, to the particular spot which he has selected for a breakfast table. This, I have found, is most often a stump or fallen tree, on which he can sit a yard or so above ground level. Sometimes, however, he appears to trust solely to his hearing (no doubt he could thread the path to safety blindfold), and feeds upon the ground. As might be expected in the case of an animal who is active, not to say impetuous, from year's end to year's end, the Squirrel has schooled himself to great variations of diet. His staple food is unquestionably vegetable, and his preference is for nuts and hard seeds. He can manage any British nut or fruit-stone (nuts he usually splits in half, but fruit-stones he has to gnaw), and he appears to possess an extraordinary nicety of perception as to whether the kernels are in good order. If you proffer a bad nut to a Squirrel, he will almost throw it at you.

Apart from nuts and fruit-stones, Squirrels are fond of all kinds of fruit containing sizable seeds—apples or pears for example, sloes, hips and haws, even corn. He is fond also of fungi, and the German naturalist Lönns describes him as getting intoxicated on the fermenting sap of oak-bark. I have a note of a Squirrel busily engaged on the bark of an old

alder, whose abundant exudation of sap caused it to be a *rendezvous* for all kinds of insects. Before reading Lönns' observation I had certainly imagined that this Squirrel was in quest of grubs and pupæ, of both of which he is mightily fond. Occasionally, as might be expected, Squirrels do considerable damage in plantations of seedling firs. So far as vertebrates are concerned, it is certain that the Squirrel will occasionally eat birds' eggs, and even nestling birds. I am strongly of opinion that this is a perversion of appetite, which occurs only in the case of a female Squirrel who is suckling her young. That a Squirrel's breeding season should correspond with that of many early nesting birds (young Squirrels have been frequently found early in March), and that the one time in the year in which she is most hardly pressed by hunger should be the one time when the supply of her natural foodstuffs almost entirely fails, is, of course, unfortunate for the birds; but who with a spark of humanity in him can blame the Mother Squirrel, let alone shoot her?



A

B

UNDER SURFACE OF (A) THE SQUIRREL'S HAND AND (B) THE SQUIRREL'S FOOT.

To show the difference in the development of the pads and the hair-coating.

The best time for observing Squirrels at large is not only early in the morning, but early in the year. This is in part due to the absence of foliage, and in part to the fact that it is in quite the early months that the Squirrel's fancy turns (even more lightly, I fancy, than that of Tennyson's young man) in the proverbial direction. The Squirrel's courtship, more especially if it is complicated by the presence of one or more rivals, is worth rising betimes to witness, whatever be the season. It is the headlong, impetuous, utterly reckless affair which one would look for in a creature of the Squirrel's temperament. The lady is fully as agile as her suitors, and the fact that the latter waste precious intervals in vainly buffeting each other, ensures a gymnastic display of a remarkable character. To begin with, one is amazed at the precision and dexterity with which each movement of the pursued is mimicked by the pursuer. My Lady Shadow-tail gallops up the beech tree, loops twenty different branches, all but misses her footing, recovers somehow, darts outward along a tapering bough, ripples from twig to twig of it, and, when twigs fail her, leaps. The larch has beckoned to her. She lands upon an outstretched feathery arm, shoots off it like a rubber ball, lands once again, bounds upward to the trunk, slithers the length of this to earth, then flings about, and scales its farther side. So she speeds from tree to tree until you lose her. In hot pursuit comes Squirrel Number One. He runs the same bough outwards, stumbles at the same spot, leaps to the same landing, and even passes her, he downwards and she upwards, on the same larch trunk. Should fortune still befriend you, you may see Squirrel Number Two. Squirrel Number One is quickly aware of him; he pauses a moment, half turns and chatters; so loses five yards from My Lady; then turns in earnest. Squirrel Number Two stops dead; both sit back on their haunches; both shrug their shoulders jerkily; both shake and stamp with rage. Presently Squirrel Number Two flings down his paws. *Thud, thud!* they strike the bough. *Thud, thud!* his hind feet echo them, each thud a half-inch progress. Squirrel Number One awaits him. He is still bunched and chattering, with his paws on guard. And now My

Lady pauses. Down come Squirrel Number One's fore-paws, *Thud, thud!* upon the bough. *Thud, thud!* his hind feet echo them. Another moment and they are at grips. You see a whirl and gleam of tails (silver-grey in the sunshine); you see small branches flicker as they touch them; you see an inextricable confusion of tree and sky and Squirrels; you see that this confusion is falling; and presently you see that the combatants have parted, each to a separate bough, some twenty feet below their starting-place. How do they do it? How can two non-winged creatures fight on snapping twigs? How can one eye be kept on one's rival and the other on a landing-place, or even a second landing-place should the first one fail?

In his excellent book on the "Sense of Touch in Animals," Dr. Kidd has pointed out a peculiar feature in the papillary ridges of a Squirrel's hand. Dr. Kidd holds that arched, whorled, or looped papillary ridges (such as occur on human finger-tips) are specialised types, and that longitudinal, oblique, or transverse ridges are primitive types. He holds, further, that the chief use of both types is in connection with the sense of touch, and that their frictional use is subsidiary. Other investigators, notably Miss Whipple, hold that the chief use of papillary ridges is frictional—they serve, that is, to "rough" the hands and feet.

One would certainly expect to find that a Squirrel's hands were specialised to avoid side-slip, and that they would also give some external indication of hypersensitiveness of touch. So far, however, as the papillary ridges are concerned, they appear to have no obvious specialisation. The ridges are few in number and indefinite in form, the most noticeable being those on the palms of the hand, which radiate forward from the proximal portion of each pad. This arrangement is unusual, and by no means self-explanatory. The pads, as can be seen from the illustration on page 650, take up such a large proportion of the palmar surface that its grasping area is practically hairless. The soles of a Squirrel's feet, however, in which the pads have oblique ridges, and are much smaller in proportion, are fairly well haired. These facts suggest to me that in the case of a Squirrel leaping from one slippery bough to another, the take off is strengthened by the hairy, non-slipping character of the soles of his feet, while the landing is broken by the elastic buffer character of the palms of his hands.

UNDER SURFACE OF SQUIRREL'S TAIL.
Showing the "banding" of the long hairs.

For a "tactile sense of the position of his body in space," the Squirrel must, I think, depend on his *vibrissæ*—it is unfortunate that we have no English word to correspond with the German *Sinneshaar* (sense-hair), for the structure of *vibrissæ* is quite different from that of ordinary hair.

The *vibrissæ* of the Squirrel, in addition to being abundant on the muzzle, appear over and behind each eye, and, farther back still, beneath the throat. The latter position is by no means a common one. He also has a growth of them in the neighbourhood of his elbow joints (the reader will remember something similar in the

case of the Stoat), and generally the portion of him forward of the shoulder girdle may be said to bristle with "receivers."

Though it is probable that a Squirrel's tail may, on occasion, serve as a parachute (it is decidedly distichous), I am inclined to think, from observation of a number of Squirrels, that this particular function is seldom in evidence, and that the main uses of a Squirrel's tail are the nice adjustment of his centre of gravity, and the provision of a warm winter wrapping. So far as the former is concerned, a Squirrel who is sitting back on his haunches (his normal feeding position), or who is sitting still on a branch, (*see* illustration on p. 648), arranges his tail S-wise, so that the main weight of it is disposed over his back. When leaping from bough to bough, or over the ground, a Squirrel's tail may be fully extended, or arched, either disposition being completely under the control of the Squirrel. When sleeping in his nest, a Squirrel, like a Stoat, wraps his tail round himself, and includes its mouth in its shelter. It serves, in fact, as a respirator and blanket combined. I am not satisfied that Squirrels ever become torpid, even in the hardest weather, or that they ever make a store. "*Improbus atque improvidus*" would be a fitting motto for the clan.

DOUGLAS ENGLISH.

ANIMAL EPICURES

By GERVAISE TURNBULL

IT is a curious and interesting study to notice the very various tastes and antipathies which animals in a state of domestication show in the selection of their food supply. Depraved tastes may occur in some cases where, as in cats and dogs, close contact with civilisation has blunted the natural instincts; but with the ordinary farm animals there is a natural selection shown, generally of a healthy character, when they are allowed to roam at liberty.

It is a wide one, too, and more discerning than might be supposed from first observation, and horses, cattle, sheep and goats, and even pigs, show their likes and dislikes in an unmistakable manner. Horses, we all know, are most particular in the foods which they will eat when in the stable, and if they show less discernment when grazing they have their fancies, though probably not to the same extent as sheep. Their chief characteristic when grazing is the way in which they pare the grass closely down in certain places, leaving a patchy appearance in the field. This points to a difference in the taste of the herbage, which, though apparently the same to the observer, horses are not slow to find out. Indeed, it is noticeable what a preference live stock generally show to one field over another, due largely, no doubt, to one being of better quality than the other, but also, perhaps, because some particular kind of herbage or plant is there which they affect.

It may, perhaps, surprise the general reader to learn that a very large number of plants may be growing in a grass field that appears to the casual observer to be "nothing but grass." The subject was carefully gone into some years ago at Rothamsted, the great scientific station for agriculture, and on the plots there grown as many as eighty-nine kinds of plants were found. Only twenty of these were grasses, and ten leguminous plants, so that there were a large number of weeds, as they would be called in arable ground, though no doubt many of them would be appreciated by live stock.

It will be interesting to trace the particular plants that grow in this way, and also in hedgerows and similar places,

that are singled out by different kinds of live stock when they are browsing at liberty. We all know that horses are partial to the leaves and bark of trees, owing possibly to the tannin which they contain. This substance, in moderation, is considered by some to be of use as a tonic. Some leaves, such as the oak, contain rather a lot of tannin, and would hardly be so valuable for fodder as those which contain less. The idea of making use of leaves for fodder may seem a strange one, but the foreigners have for some years been ahead of us in this respect, and in France vine leaves are largely used.

Osier leaves, willow and lime are supposed to be useful in England, as well as those of the oak, birch, beech and poplar. A year or two ago some interest was aroused in the subject, for a herd of cattle was enabled to live on a leaf diet through a burning drought where they would otherwise have starved—for cattle like leaves as well as horses. They are aromatic, like the spices which are relished in patent stock food, and here, doubtless, lies their attraction, added to a pleasing sense of a change of diet, which all animals so much appreciate, especially if it is stolen !

Horses have also dislikes peculiar to themselves, and this is seen in the case of the sow thistle, a very common weed, rich and free growing, which is a favourite food with many animals—notably pigs and rabbits—but is refused by horses. Possibly it is too bitter, but this hardly seems likely, seeing that this is the case with so many edible plants. Gorse is a plant which horses appreciate when ground up—it seems to be used more in Ireland than in England. It is doubtful, however, if they would do more than eat the young shoots if the plant were not first prepared in a gorse-mill which turns the prickly stems into excellent provender, reputed to give a good sleek coat, and to be of use also in a medicinal way. There are many plants that seem to act in this manner, with sheep especially, and likely enough when not feeling quite fit, animals pick out certain plants which do them good, just as cats and dogs eat grass.

Sheep eat young gorse shoots also, but their natural diet is rather different from that of horses or cattle, and it is well known that both sheep and goats, especially the latter, have a wide range of taste, and eat some plants which cattle will not touch.

For instance, they eat agrimony (*Agrimonia Eupatoria*) but most cattle refuse it, and they will sometimes eat the young shoots of heather, but no cattle seem to care for the fine-leaved heath, or Scotch heather (*Erica cinerea*), a very similar plant to the common heather or ling upon which the grouse thrives.

Sheep eat most of the plants which are attractive to cattle, but they seem to dislike some of these ; cow-wheat (*Melampyrum pratense*), for instance, is rejected by them. This seems strange, as the plant is considered to be a valuable food for cows, and Linnæus said that when cows are fed in fields where this plant is abundant the butter they yield is peculiarly rich and brilliantly yellow. According to Dr. Prior the curious name comes from the fact that " its seed resembles wheat, but is only fit for cows." There seems to have been an old idea amongst country people that the little seeds of the plant could be turned into wheat as they fell.

Amongst those plants in pastures which sheep eat but which cattle reject are ragwort, knapweed, and ox-eye daisy, an uninviting trio, certainly, and it is not surprising that cattle should consider such dry, harsh food as beneath their notice. Wild wallflower seems unpalatable enough, but sheep will eat it, and it is said to be quite wholesome, and, moreover, very useful against certain diseases, —an instance of a medicinal herb again— and in days gone by it seems to have been actually sown for sheep-feeding, along with sheep's parsley, another herb with a good deal of flavour.

Sheep are fonder of such pungent plants than are other live stock, but it seems to be a mistaken notion that wild thyme (*Thymus serpyllum*) forms a valuable part of the herbage on upland pastures to which sheep are partial. It was supposed to improve the quality of the mutton fed upon it, but probably, like many other curious legends which have grown round some of our wild plants, there is no truth in the notion.

Common tormentil is another little plant with more claim to attention, because it is said that besides being nutritious as a herb it has the singular and very useful property of keeping at bay that great scourge on damp pastures—foot-rot; for where tormentil is grown this tiresome and painful complaint seems not to exist, but this is one of those old-fashioned remedies so seldom seen in practice that we may doubt whether it is even known to many farmers.

There are a number of wild vetches, and as many as ten species are reputed to be of use as pasturage for cattle, though they are not cultivated. In olden times more seems to have been thought of them than is now the case, for an old worthy, Dr. Plot, says in his "Natural History of Stafford" that tufted vetch (*Vicia cracca*) and wood vetch (*V. sylvatica*) are able to "advance starven or weak cattle above everything yet known." This sounds curious in these days of cattle foods, but no doubt some of these plants are distinctly valuable, and all cattle seem to like the bush vetch (*V. sepium*), extolled by Gerarde, which grows early and late. *Lathyrus sylvestris* is another handsome and very valuable wild plant, the narrow-leaved everlasting pea, or Wagner's pea, a plant with infinitely more nutriment in it than most of those mentioned already, yet cattle do not take to it very readily.

The likings of some live stock are very curious, and seemingly irrational as regards the buttercup tribe, for if we may believe one authority the field crowfoot is greedily eaten by cattle, but is fatal to dogs and sheep, which are not easily poisoned. All the crowfoots are acrid, and, as a rule, are disliked by cattle; indeed, cases of poisoning have been traced to their consumption of them. The water buttercup (*Ranunculus aquatica*) also is said to be liked by cattle and even to be nourishing, but cattle are not fond of the ordinary buttercups in the meadows, and as far as they can they do not eat the flower stalks and heads, though it must be difficult for them to avoid eating the leaves. The notion that buttercups give a rich golden colour to butter seems therefore to be quite a mistaken one, but it was a very common notion at one time, and "John Buttercup" was a familiar name for a dairyman.

Some plants have very curious attributes, and *Polygonum aviculare* is one of these. It is the common knot grass, and is one of the least attractive and luxuriant of plants, yet in olden times it seems to have been much thought of and valued as a "suet producer." Milton and other writers have insisted on the partiality which cattle and sheep show towards it, but this seems rather doubtful, as it is so much in evidence as a weed in some fields.

Some weed plants, such as the sorrels, are held in estimation by all kinds of live stock, and in the same way a few, such as the spurge laurel, are universally disliked; but goats will eat deadly nightshade, henbane, and other poisonous plants!

GERVAISE TURNBULL.

HOW TO KNOW THE BIRDS

By the REV. MAURICE C. H. BIRD, M.A., M.B.O.U.

THE SWIMMERS—I

THE Moorhen and Coot, last referred to, form the connecting links between the Waders and Swimmers. Foremost among the swimmers are the Geese—large birds, with oval-shaped bodies, long necks, and short, stout beaks, tipped with a distinct nail, the varying colour of which in the different species is, in some cases, an aid to identification. The strong beak, high at the base and rapidly falling away to the flattened-out extremity, is well adapted for cropping vegetation. The wings are long and powerful, and the legs, placed well under the centre of the body, afford ease in walking. All the Geese are gregarious, visiting us only in winter, and then chiefly seen —except by those who follow them for sport—whilst flying high up in the air from one feeding-ground to another. They proceed either in V-shaped formation or in an irregular line in which each individual keeps at an even distance from its neighbour. The leader drops to the rear when tired with the extra exertion of cleaving the air for its followers.

On the wing, Geese are unmistakably larger than Ducks, and may be distinguished at a distance from the larger Gulls by their more rapid and heavier flight, long, outstretched necks, shorter tails, and larger bodies in proportion to the wing-spread. They may be divided into Black and Grey Geese. The former are practically sea-birds, whilst the latter procure their food—grass and the blades of young corn—from the marshes and uplands. All species are shy and wary, and seldom feed without leaving a sentinel on guard.

Although the Black Geese, Brent and Bernacle, are probably only likely to come under the notice of many of my readers when hanging up on the poulterer's stall, yet a few remarks upon them may perhaps prove acceptable. The Brent is the commoner of the two Black Geese,

Photograph by P. Webster, Newcastle-on-Tyne.

HOOPER SWAN.

and it is also the smallest British Goose—only about 21 inches in length; the Bernacle is some 4 inches longer. At first sight the Brent appears to be quite black, but at close quarters adult birds show an irregular white neck-ring, and have a white patch under the tail. The Bernacle chiefly occurs on the west, whilst the Brent prefers the east side of our coast; has head, neck, and throat black, with white cheeks. The back is lavender-grey barred with black and white, and the under parts are grey and white. The legs and feet are black in both species.

Of the Grey Geese, the White-fronted

is least likely to be confounded with any other species; it is the most slender in shape, and has a conspicuous white forehead, whilst the breast is irregularly blotched with black. The hoarse and oft-repeated "ha-ha" note has given this species the name of the "Laughing Goose." In length it is about 27 inches; but measurements alone cannot be depended upon for identification purposes, as they differ according to sex and age in most birds, and according to race with some—the more northern forms being generally the smaller.

Grey-lag, Bean, and Pink-footed Geese much resemble one another. The first-named was once a resident in the eastern counties, but now only breeds sparingly in the north. It is the largest British Goose, measuring nearly 3 ft., though the Bean is only an inch or so shorter, and the Pink-footed is about 28 inches. The Grey-lag has flesh-coloured feet and beak, white nail, and grey rump and wing coverts. The Bean has yellow legs, brown beak with black nail, with sometimes a little yellow showing on the centre of the beak. The Pink-footed is somewhat similar, but its legs and the centre of its beak are flesh-coloured and the nail is black.

The Grey-lag sometimes has a little white at the base of its beak and some black feathers on the breast, but its flesh-coloured legs and larger size will distinguish it from the yellow-legged and less heavily built White-fronted species.

Two kinds of Wild Swan visit us in hard weather—the Hooper and Bewick. Both may be known from the Mute Swan, not only from the beak being lemon rather than orange yellow, but also from the fact that the tip of the beak is black and the base yellow, instead of *vice versâ*, as is the case with the tame species. On the water they both—and the Hooper especially—carry their necks more erect, with the beak at right angles to the neck—not depressed as is usually the case with the Mute species. The Bewick Swans are more Goose-like and sociable, and keep closer together than the Hooper whilst feeding. The heads and necks of both species are often stained to an orange yellow from the colour of the water in which they feed. Their measurements are respectively 5 ft. and 3 ft. 9 in. The young of each are dark grey in the first season, and light grey in the second.

The small price which these birds fetch in the market should tempt any naturalist

Photograph by P. Webster, Newcastle-on-Tyne.

MUTE SWAN ON NEST.

to purchase one, if only for the purpose of examining the double-keeled breastbone, between the two walls of which the elongated windpipe passes and returns ere it enters the lungs. It is supposed that this is a provision of Nature to enable the bird to feed in icy cold water —the frigid air being therein warmed on its passage to the lungs.

MAURICE C. H. BIRD.

THE SEDGES—I

By MAUD U. CLARKE

With Photographs by HENRY IRVING

THE tribe of the Sedges (*Cyperaceæ*) resemble the Rushes in some respects, but more often the Grasses, both in the leaf arrangement and also in the construction of the flowering schemes. For the most part, however, the leaves are stouter and stiffer, with the leaf-sheath wrapping entirely round the stem and unsplit. The flowers are often rudimentary, contained in green or brown spikes, solitary or terminal; the capsule being one-celled holding one nut-like seed. It is a very large family and possesses most variable characteristics, spreading over the world in all moist situations. It forms an intermediate class between the Grasses and Rushes, distinguished from the former through the absence of the secondary or inner protective scale—the palea—that surrounds the flower of the Grasses; and separate from the Rushes as possessing no regular perianth or flower. The glumes of the Sedges are mostly brown, or greenish-brown. The *Carex* stand out amongst them as a specialised type, well-defined and apart, on account of certain botanical distinctions which I will not particularise other than to mention the three-angled stem devoid of joints or solid nodes. The Greek term *Keiro*, I cut, gives the family name to this species, in respect of the sharp edges of the leaves, which character seems further expressed by the bayonet shape of the stem.

The leaves are noticeably sharp in the case of *Carex vulpina*, the Great or Fox Sedge, one commonly met with in wet ground. The height is variably from two to four feet, half a dozen grassy leaves springing from the stem at the lower six inches of its growth, the remainder shooting upwards bearing the green or pale-brown spike at the top. The length of the spike itself is also variable, from one to three inches.

The bracts associated with the flowering glumes are widely spread and bristly; the whole spike when in the seeded state being stiff and harsh with the beaked glumes and pointed bracts.

The surface of the angled stem is grooved, shining, and of a very beautiful green colour. The flowering continues through June and July, and by August the stiffened heads show the beaked fruit encased within the bracts. Sometimes one comes upon this Sedge tufting up under shelter of the gorse on commons where there are water-holes below, making beautiful curved lines of bright green against the sombre spinous growth. In such places the gold flowers of the Lesser Spearwort often glitter in quantity, the plant we recognise as a buttercup in the flower, yet differing from it in growth and leaf-structure. Quite likely the Water Crowfoot, too, may be there, spreading a patch of its green linear leaves over the ground, with a white flower or two still showing though the pool has become grass-grown.

It is certainly a rather confusing matter, when one's knowledge of plants is a little

limited, to attempt dealing with the items of a conglomerate of species growing on any yard or two of damp ground on our commons or waste lands. There are plants that look like something we know, only there is a perplexing variation that convinces one it is certainly not that plant but another. One stumbles upon the illimitable power of variation, the expression of Nature's wonderful flexibility; it is there for us to learn of, or let alone according to our bent. In just such a water-hole, or in its immediate neighbourhood, we may also find *Carex leporina*. It is a far more slender species, with long, thin stem of the same three-angled form, sometimes rising as high as four feet when pushing through the undergrowth, or may be only twelve inches, as circumstance allows. The grassy leaves are much narrower than those of *C. vulpina*, tapering into almost thread-like form at the extremity. The outer scales at the base of the spikelets also terminate in fine hairs longer than the scale itself. The flowering head is usually composed of five or six spikelets placed in close succession round the axis of the stem; on close examination they show very fine hairs bending from the point of the glumes. These hairs, in the early flowering stage, give a very soft effect to the whole mass.

GREAT OR FOX SEDGE.

Provided the damp situation is given, we can find these Sedges in very many different combinations of circumstances and surroundings, especially in such quarters as those of a boggy common. I have found them piercing through the bramble vines, with the little Marsh Speedwell spreading below, or springing up above water grasses such as the Floating Fox-tail and Flote Grass; or growing clear out in the open, surrounded by the Carnation Grass, stiffly erect, curling its grey-green leaves like ornamental ironwork. This latter plant is also a Sedge, by the way — *Carex panicea*. Enthusiasts never tire, as a rule; and if plants happen to be the objects for the enthusiasm, the eyes of the enthusiasts are always ranging the ground for possible discoveries of that sort. In this way little *Carex flava* may be happened on, even if only showing its minimum presentation of three inches, when it is an inconspicuous greenish plant rising from green grass.

There is no mistaking the Sedge character when once known, with its spikelets set upon the flower stem rising vertically from a tuft of grassy leaves. The height may be as much as eighteen inches, the plant being easily recognised by the yellowish-green colour of both leaves and spikelets. The fruit is beaked, and set outwards from the axis of the spikelet, sheathed with bristly bracts.

In the illustration (p. 659) the two topmost spikelets are shown in the dried-off stage, when the soft mass of closed bracts becomes a silvery fawn colour. They are the staminate spikelets holding the staminate flowers; the lower ones of the stems are always the pistillate, or fruiting spikelets, either stalked in some species, or set close to the stem.

In *Carex Goodenovi*, the Common Tufted Sedge, we see the pistillate spikelets set closely together with the staminate one at a distance; whereas in *Carex remota*,

CAREX LEPORINA.

British Sedges of the *Carex* family, each adopting its own particular mode of growth, or specialisation. Of the two last-named species, the latter, a slender type of Sedge, likes damp copses or places where there is some sort of shelter; whereas the former, with a stout three-angled stem, finds its home in wet fields or marshes in the open.

There is much diversity in the relative position of the spikelets with regard to each other, and in the length or shortness of their stalks—*Carex glauca* having in the lowest pistillate spikelets five curving stalks of perhaps two inches long; *C. muricata*, or Great Prickly Sedge, having the very small spikelets the Distant-spiked Sedge, the reverse plan becomes the habit of the plant. There are over seventy varieties of quite stalkless and set in the leaf-angles of the stem. Its growth is slender, with narrow leaves and a rough three-angled stem, and it is found in a tufted fashion on dry pastures. Of the stouter species, when the stems run to four and five feet high, making great masses of growth as much, perhaps, as four feet across, one might name *Carex paniculata*, the Great Panicled Sedge; *Carex acutiformis*, the Pond Sedge; and *Carex riparia*, the Greater Pond Sedge, and largest British species, with as many as twelve large spikelets—a ditch plant and quite common.

CAREX FLAVA.

The Wood Sedges are mostly familiar to us—both *Carex sylvatica* and *Carex pendula;* although, perhaps, *Carex depauperata*, or Starved Wood Sedge, is not so commonly met with. As the name

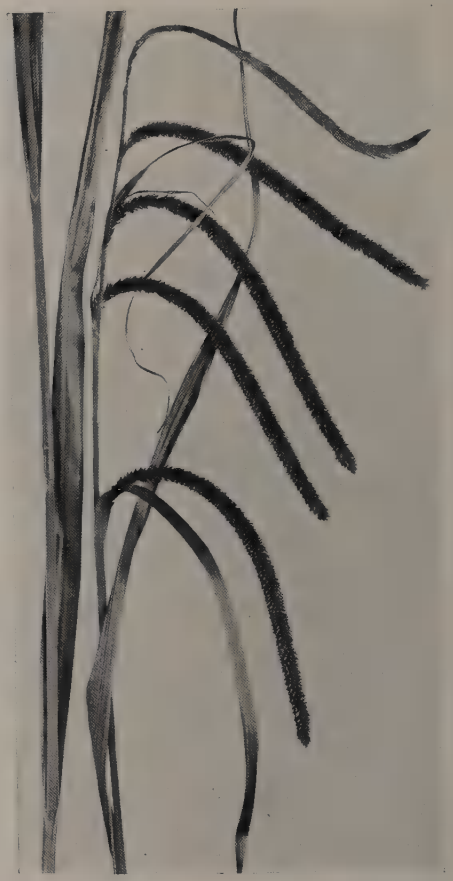
COMMON TUFTED SEDGE.

suggests, the habitat is a starved soil in dry woods; and although the plant grows two feet in height, it has a slender, feeble character, the spikelets

CAREX SYLVATICA.

being very abbreviated and the fruits few.

Carex sylvatica, on the contrary, has long fruiting spikelets from one to three inches, curving downwards on slender stalks. In damp woods it may grow three feet high, making strong tufted growth. The Great Drooping Sedge (*C. pendula*) is a very imposing species that sometimes runs up six feet, hanging out long, closely-set spikelets, with the stalks hidden in the sheaths. The leaves are lengthy, quite half an inch broad, making great masses in the wet hollows. Such places are generally marked with a vivid green, all growth suggesting the luxuriant cell-formation of the water-loving plants. I have seen the seedling growth of *Prunella vulgaris* spreading like Duck-weed on the firmer yet saturated ground, with the inevitable Soft Rush tufting up beside the black rotting *débris* of the woods—broken bark and larch cones spotted with fungi, and all



GREAT DROOPING SEDGE.

manner of plant structure in fractional condition passing through the chemical transformations that eventually extinguish their recognition.

MAUD U. CLARKE.

THE CLOCK TOWER, ST. ANNE'S, DUBLIN.
From the Water-Colour Drawing by E. A. Rowe.

Photograph by F. Mason Good, Winchfield.

AN IRIS GARDEN NEAR CAMBRIDGE.

THE WILD GARDEN

By H. H. THOMAS

IT is a strange though common fallacy to assume that the wild garden is necessarily a garden run wild, for this assumption reveals only half a truth. There must be order in the wild garden. Even Nature is methodical in her direction of the ways of plants and flowers. First, and perhaps most important of all, there must be some method in the selection of the plants; and their arrangement is a matter of scarcely less moment. One must have plants whose beauty is found chiefly in their vigour and virility, and those whose charm lies largely in their frailty. One kind must not override the other, or there will be chaos where there should be natural order: and the chaotic wild garden is no garden at all; it is simply a collection of plants run wild. The most successful wild garden is made on the woodland fringe where there is an open space among the trees. There must be luxuriant beauty everywhere, grace of leaf and charm of blossom. The happiest wild garden is found where there is perfect commingling of foliage and flower.

One season is scarcely more fascinating than another in the wild garden that fulfils its destiny under skilful guidance. In the depths of winter, when snow lies heavy on evergreen boughs and frosted twigs scintillate in the winter sunshine,

when Snowdrops and Crocuses, Aconite and Lenten Rose, make fairy carpets of blossom in sheltered nooks, and the Winter Sweet and Jasmine, Daphne and Witch Hazel, strike a note of refreshing colour among shrubs for the most part bare of leaf and blossom—even then there is beauty and to spare in the wild garden.

Photograph by F. Mason Good, Winchfield.

COLONY OF FOXGLOVES IN THE GARDEN, FORD ABBEY, CHARD, SOMERSET.

As "winter dies at the soft sweet breath of spring," the woodland trees, grim in their stately solitude, lose their individuality, merge their austerity in perfect association with the garden growing up around them. The bursting buds show green against the brown, so tempering the aspect of the giant boughs that soon their frown becomes a smile. And, answering to the silent call, the hard ground softens, the dank earth dries, the shrubs take on their tenderest tones, and the flowers of spring break quickly into blossom. Then—as gradually a verdant canopy and deepening shade envelop wood and garden—below, the twigs yield up their leaves, the branchlets give their blossom, and the ground marshals in ever-increasing array its pageant of gaudy bloom. Daffodils and Bluebells, Squills and Windflowers, Violets and Primroses, join the swelling throng.

In summer time the glades are aglow with Roses—Dog Roses, Japanese Roses, Musk Rose, and Sweetbriar; the air is redolent with the fragrant breath of Honeysuckle, of Lilac, and ablaze with the bloom of Azalea and Rhododendron. Where the shade is dense, Ferns cover the ground with a canopy of fairest green, while here and there Foxgloves in white and rosy purple, Bellflowers in blue, and sometimes a lowly carpet of white Woodruff, throw welcome colour on the leafy screen.

When

> "There's a tinge of grey in the land of bloom,
> And the song of the birds is hushed,"

the wild garden has still an exquisite

Photograph by F. Mason Good, Winchfield.

A WOODLAND WALK.

charm. The dying glory of its autumn leaves, the golden glow of Coneflowers and Sunflowers (which—strange anomaly!—are not unhappy in the shade), Aconites and Japanese Anemones, Starworts and Moon Daisies: these and more invest it with a charm that casts a magic glamour. The successful wild garden is full of hidden beauty. The walks wind with seductive curves, exposing here and hiding there, now overgrown by untrammelled Rose, now with fragrant fringe of flowering bush. Grassy ways with moss-grown banks lead on to richer beauties, themselves, well clothed with seedling fern and self-sown flower, compelling admiration.

Photograph by F. Mason Good, Winchfield.

THE WILD GARDEN, WISLEY.

The most delightful wild garden I ever knew was fashioned out of a small woodland where the dusky tops of giant Scots Firs towered high above the rugged boles, casting a gloom in winter, a sombreness even in summer. The garden had grown gradually, as all true gardens must. One cannot make a garden as one would build a house. "Men come to build stately sooner than to garden finely." The digging and delving and subsequent planting had been a long labour of love. The soil was light and sandy, so there was no need to gravel the paths; these were dry even in the depths of winter. There were surprises at every turn. Now and again each path would open upon a little green, safely hidden by Bamboos, by Rhododendron and other close-growing shrubs. Winter Aconites and hardy Cyclamen, Snowdrops and Crocuses, dappled the mossy grass with early colour, while round about the shrubbery fringe were little colonies of Daffodils, Snowflakes, Japanese Primroses, and other flowers in which the wild garden delights. But the fern dells were its beauty spots; these had been dug out some five feet deep, and the excavated soil formed high banks on either side of the narrow path. These were masses of pleasant leaf and occasional flower, formed chiefly of ferns, London

Pride, Ivy-leaved Toadflax, St. John's Wort, Periwinkle, Bellflower and Foxglove. The paths leading to these leafy dells were cunningly contrived, and, like some merry child at play, would wend hither and thither, and at the moment least expected discover to you the goal. Vigorous creepers climbed high up some tree-trunks, chief among them being Dutchman's Pipe, clambering Roses, ornamental Vines, the large-leaved Irish Ivy, Virginian Creeper, Polygonum or Bindweed, and Old Man's Beard or Traveller's Joy. Most of these veiled rather than hid the giant boles, scarcely detracting from their innate charm while investing them with a fresh strange beauty.

Then in high summer-time the glory of this little wild garden lay in its clumps of orange and scarlet Lilies, Madonna Lilies, Azaleas, Mock Orange and Giant Spiræa; and round about the little pond there clustered golden Marsh Marigolds, Siberian Iris, Lady's Smock, Flag Iris, Japanese Iris, Reeds, Rushes and Sedges. And casual sunbeams filtering through the Fir-tree tops, touched to brighter lustre the moisture-loving flowers, and brought an unwonted radiance to the water surface.

But after all there is no wild garden comparable with that fashioned by Nature with her own wild flowers. Take note of common effects on the woodland fringe, the roadside ditch, the hidden hollow, and see with what simple material Nature achieves her most gorgeous effects. Flowers are not found in twos and threes dotted here and dotted there, but in bold and striking groups, in soft and graceful masses. First of all choosing the spot that grows them best, Nature poses them in great sheets of leaf and flower so skilfully that while they combine to form one harmonious whole, each is complete and satisfying in itself. The most fascinating wild-flower scene I have ever come across was found in a meadow in South Bucks. From end to end, from side to side, bounded only by the limiting hedges, the meadow grass was covered so thickly as from a short distance to appear hidden by the Purple Orchis, a great and wonderful mass of colour such as the wild flowers of this country seldom deign to show. Another scene that haunts the memory and brings home to one the wondrous beauty of even the prosaic highway is that of a small pond, its stagnant surface smothered beneath white, yellow-centred blooms of the Water Crowfoot.

He who would plant a wild garden should carry such scenes as these in his mind's eye. They will influence his work, and perchance when the garden has grown it may be found that the fascinating spell which memory weaves has imparted to the artificial garden something of the naturalness of the wayside and the wilds, a naturalness that admits of no explanation yet carries with it the glamour that distinguishes a garden from a mere collection of plants.

H. H. Thomas.

THE SEDGES—II

By MAUD U. CLARKE

With Photographs by HENRY IRVING

THE Common Cotton Grass (*Eriophorum angustifolium*) to ordinary observation certainly appears a flowering grass, with the scheme carried even further towards the realm of flowering plants than in others. Yet the characteristics upon examination place it distinctly as of the tribe of the Sedges and apart from the Grasses. In the first place there is the solid versus the hollow stem; and although the umbellate cluster of cottony tufts, so like an elaborated mass of stamens, is suggestive of the flowering plant, yet are they widely different in actual construction and purpose. For in the Sedges the perianth, or collective scheme of corolla and calyx, is either absent or merely represented by scales or bristles. The white tufts of the Cotton Grass are a mass of these bristles extended, sometimes as much as two inches in length, and of beautifully silky texture, for this species has perfect flowers though of minute proportion. Some of the spikelets are fixed on the stem, others project further out on long smooth stalks, the whole group, varying in number from three or four to twelve, emerging from a large membranous bract expressed at the top of the stem. The leaves are sharply channelled at the base, the under side being "keeled" in character, as shown in the base of the broad blade to the left-hand side of the illustration. In the blade springing from this one and arching to the right, we see another characteristic of the Sedges in the way it is folded flatly together longitudinally. This species is a tufted perennial plant of one foot in height, with erect flowering stems rising from the mass of grass leaves. It flowers early in the year through May and June, and although described as common, I have not found it growing in many apparently appropriate places. As my personal acquaintance with the plant is confined to the Long Valley, Aldershot, I should feel inclined to regard it as being local rather than common.

COMMON COTTON GRASS.

In the wet hollows of our woods, *Scirpus sylvestris*, or Wood Club Rush, spreads its shining channelled leaves in thick patches, the stout stem of two or three feet bearing the umbellate panicle of spikelets during July and August. It possesses a perianth of six bristles, very different in character from those of the Cotton Grass, for the small dark green spikelets only show the little

WOOD CLUB RUSH.

TWIG RUSH, OR PRICKLY CLADIUM.

MUD RUSH.

MARSH SPIKE RUSH

point tipping the glumes that gives a slightly softened appearance to the group; the interior bristles are invisible. The umbel is complex in the variable length of the stalks of the panicle, and again in that of the individual spikelets. There is, further, a fringing of leafy bracts that spring from the axis of the umbel in addition to the leafy extension of the flower stem itself. In true Sedge fashion the blades fold flatly together in the early stage of growth, giving a generally flattened formation to the whole tuft of blades grouped together in something of a fan shape. The further expansion spreads them broadly open, when they curve freely outwards from the flower stem; the deep groove or channel, however, never becomes obliterated.

This character is repeated in the Twig Rush, or Prickly Cladium (*Cladium mariscus*). Here we have one of the isolate species as far as Britain represents the class. Approaching near the Beak Sedges, it is distinguished from them in habit, although coming nearer in some of the exotic varieties.

One of the distinguishing characters is the thick texture of the fruit. The nut-like seed tapers at the top, the outer coating being dense and fleshy until dry, when it becomes brittle. It is a bog or marsh plant of most temperate regions, with a representative in some tropical parts. In Britain it is scattered, not perhaps commonly, over England and Ireland, but is quite local in Scotland. I have met with it in Wiltshire, growing in the run of a very old mill-stream, where the water entered a meadow through an underground channel which cut a deep ditch and collected the mud about the roots of the water-plants. The Bur Reed flourished there also, and many square yards of the Soft Rush spread into the grass—a haunt of the moorhens and yellow wagtail. This Cladium is a tall rush-like plant, with strong, creeping rootstock and leafy stems varying from three to six feet high. The leaves are erect, or nearly so, the lower ones nearly as long as the stem, which they sheath at the base, becoming afterwards sharply keeled and terminating in a long, narrow point. The keel and edges are very sharply cutting, being bordered by minute teeth. The collective panicle of spikelets is long in shape, sometimes twelve inches; the individual clusters are small but numerous, of pale-brown colour, set in the axils of the upper leaves. The group of glumes contains usually one perfect flower in the innermost glume, an incomplete one in the next, whilst the four or five outer ones are empty and shorter in formation, the stamens being two in number. The plant flowers late in the summer.

Our next illustration certainly inclines one to regard it as a Rush rather than a Sedge. Nevertheless the Mud Rush (*Scirpus holoschœnus*) is a true Sedge by reason of many distinct characteristics, notably the nut-like seeds enclosed in the mass of glumes that form the brown globular heads, and held as lateral umbels on the stem.

In this species, as in some others, the outer bract of the umbel is prolonged as a stiffened extension that tapers to a fine point. The secondary bracts are variable both in length and strength. In the upper portion of the right-hand specimen we see how the bract has rolled inwards at the edges, producing the stiffened strength of an almost cylindric form. The four-foot stems are so throughout, with one or two stiff leaves only, wrapping the extreme base. As the name suggests, it is a mud-loving plant—the tidal mud of our southern and western shores, where sand mingles with it. There are other varieties, including the *Scirpus fluitans*, or Floating Mud Rush, a slender-jointed plant; *S. cernuus*, the Bog variety, a much slighter plant of only ten inches in height, and the Bristle-like Mud Rush, *S. setaceus*, that is smaller still, sometimes less than six inches. All of them are perennial in habit, but *S. holoschœnus* flowers later than the others—during September and October.

The Marsh Spike Rush is strongly individual in expression, and possesses four differing methods according to circumstances. The tribe *Eleocharis*, of which *E. palustris* is the representative selected, are named from the Greek terms *helos*, a marsh, and *chairo*, I rejoice. This Marsh Spike Rush rejoices in its habitat as a creeping plant, with strong rhizome that branches, sending up the slim stems with their terminal flower spikes high above the water line.

This is the all-important determination,

for the plant is content with six inches of growth on the wet margins of pools, whereas it will strive to attain double that height and more when the pool surrounds it. There is a certain resemblance to the Plantain flowers in the dark brown collection of glumes, flecked in colour with their pale papery edges and green keels. The length of the head is not usually more than half an inch, the perianth having four or six bristles, with the flowers perfect. Circular at the base, the stems have a tendency to flatten above into angles; they are enclosed in sheaths that terminate squarely where the stem escapes, as seen in those of the illustration, attached to the rhizome. These sheaths are again protected at their junction with the root by a membranous bract-like structure that is evolved from the outer skin of the root itself.

SCIRPUS LACUSTRIS.

When growing in-shore the leaves are of a tufting habit, as are the flowering stems; but if the plant is surrounded by water, and the additional height is necessitated, the stems become more solitary, as if the formative instinct resorted to economical measures. Since the effort to maintain safety for the flowers had extra calls made upon it, the reserve force of the plant was restricted in the multiplication of stems. There is something limited in the appearance of this plant; it scarcely appeals to us as others of the Sedges do, nor does it suggest that it has attraction for the insect tribe.

We have now come to the last of the Sedges selected, and one that takes us at once in mind towards the Rush tribe in much of its exterior formation—*Scirpus lacustris*, or what was once called the Common Bulrush. Nowadays most people associate that name with the Reed Mace, the club-headed *Typha latifolia*. At first glance we are reminded of the Soft Rush in the upper portion of the long, vertical stem, with its loose, pithy structure, yet the straggling upright panicle of spikelets recalls that of the Hard Rush, whilst the two flattened leaves showing at the base of the stem at once mark off a differentiation from the Rushes. The true Rush has cylindric leaves.

In respect of leaves, *Scirpus lacustris* is variable; they become flatter, longer and more grass-like when floating in running water, whereas in still water they are abbreviated and inclined to roll in upon themselves from the edges. The plant is also found in a leafless condition, when, of course, it approaches the Rushes in appearance more nearly. In height it surpasses either of the two species named, rising from three to as many as eight feet; the stem is always spongy rather than solid, although a section may measure an inch in diameter.

There is a subtle but distinct resemblance in the character of the umbel of flowering spikelets to that of the Flowering Rush. These spikelets are a red-brown colour, forming oval, almost pointed groups.

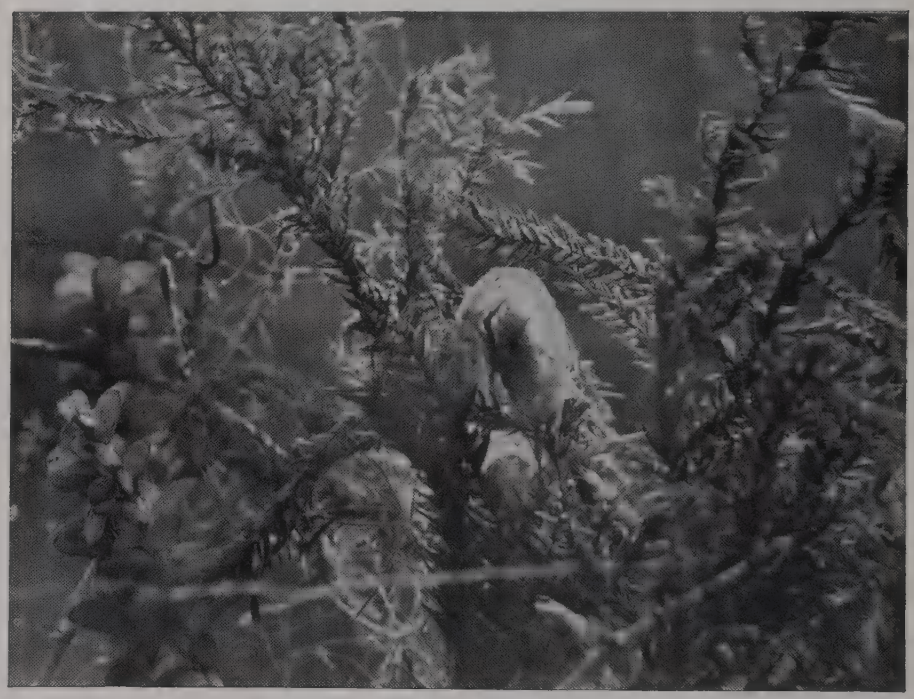
Here we are reminded on the one hand of the three-angled stems of the *Carex* specialisation of the Sedges, and the grey, bloomy stems of the Hard Rush on the other. It is the same story woven within the history of all development of species, that of unity of possibility expressed in diversity, so that we may say quite reverently, "None is afore or after other, none is greater or less than another."

MAUD U. CLARKE.

POND LIFE—II

By F. MARTIN DUNCAN, F.R.P.S.

With Photographs by the Author



THE NEST OF THE WATER SPIDER.

ONE of the most interesting of the pond insects is the Water Spider (*Argyroneta aquatica*). Crawling and running over the broad, flat leaves on the surface of the pond, it does not attract much attention, for it looks like an ordinary spider with black, hairy legs and a brownish-grey body; but when it dives beneath the surface, the Water Spider becomes transformed into a striking and beautiful creature with a body that looks as if it were made of polished silver. This sudden change in appearance is due to the fact that the body of the spider is clothed with very soft and fine hairs, amongst which a film of air becomes imprisoned when the insect enters the water. This spider, indeed, is a veritable diver, carrying its own air supply from the surface, down to the bottom of the pond. It may also be considered the true inventor of the diving-bell, for it builds a more or less dome-shaped home amongst the stems of the submerged weeds, and fills it with air, so that it looks as if it were composed of quicksilver.

It is a very pretty sight to watch one of these Water Spiders at work, filling its aqueous nest with air, and is one that may be easily witnessed by keeping a few of these spiders in an aquarium in which some water-weeds are growing. The spider will appear to be very busy amongst the stems of the water-weeds, moving rapidly from one to another, weaving fine silken threads that serve as foundations for his home. Except where the light

catches them at a certain angle, it is practically impossible to detect these threads, so that unless one is thoroughly acquainted with the habits and methods of the spider, one is rather apt to look upon its hurrying from one stem to another as a somewhat useless waste of energy, and an altogether profitless performance. In a little while, however, when the weaving operations have been more or less satisfactorily completed, the spider commences fresh tactics; it pays a succession of visits to the surface of the water, and each time it descends takes with it a large supply of air-bubbles. If we now watch the spider carefully, we shall see that at each descent it makes straight for the spot amongst the stems of the water-weeds, where it has been so busy, and proceeds with the aid of its wonderful comb-like claws to comb out from the body-hairs the entangled air-bubbles. This performance is repeated again and again, until the little dome of the "nest" becomes clearly visible, as though composed of burnished silver — an effect produced by the imprisoned air which the spider has brought down from the surface and thus stored away. The Water Spider, like all her species, is armed with powerful, hollow jaws with a fine opening at their point, through which she sucks the juices of her prey, and many a soft-bodied water larva falls a victim to her guile.

WATER "STICK" INSECT OR POND-SKATER (*RANATRA*).

Mimicry plays an important part in the lives of many pond insects. For instance, a common object that is to be seen floating on the surface of almost every pond, and which at the first glance appears to be a slender piece of stick, is the Pond-Skater (*Ranatra*). If we cautiously drop a small stone into the water, the little piece of stick suddenly becomes animated, and darts away, skimming over the surface of the water at a rapid rate. Looking closer, we see that what we at first mistook for a piece of stick is really an insect, and that attached to the body are six very thin, fairly long legs. This Pond-Skater, or Pond "Stick" insect, as it is sometimes called, lives at the surface of the pond, and moves about with great rapidity by means of its delicate slender legs. It is in many respects a remarkable insect, and its movements are well worth closely watching. A few minutes' careful observation will reveal the fact that one of the insect's popular names, at least, is a very apt one, for it will be seen that the insect does not swim through the water, but actually skates along the surface without breaking the delicate surface film. When we come to consider how extremely attenuated are the limbs of the Pond-Skater, we at once realise how impossible it would be for the insect to travel with such swift, darting movements if it had to propel itself *through* the water.

Another good example of insect mimicry —though one that it is not quite so easy to find as the Pond-Skater — is the so-called Water Scorpion (*Nepa cinerea*), which when resting amongst the brown leaves at the bottom of a shallow pool looks just like part of a withered willow-leaf. The insect is about an inch in length, and has a somewhat elliptical shaped body terminating in a pair of

tail-like organs, which, when placed together, form a breathing tube. The rostrum or beak of the Water Scorpion is composed of three joints, and contains four sharp-pointed bristles, altogether a very complicated apparatus, and capable of inflicting a very painful wound. At the approach of danger the Water Scorpion can move with considerable rapidity, and quickly reveals its true character. Under normal conditions, however, it creeps slowly about amongst the decaying leaves at the bottom of the pond, suddenly darting upon its prey, from which it sucks the blood by means of its short, complex beak.

THE WATER SCORPION.

A close and interesting relation of the Pond-Skater and the Water Scorpion is the Water Boatman (*Notonecta glauca*), which is generally to be found in the same ponds and slow-moving streams. This insect, as its popular name vaguely suggests, has its body shaped something like a boat, convex above like the keel, flat below, with a large head and very large eyes. The front and second pair of its legs are short, but the hind pair are almost twice as long, are furnished with long hairs, resemble oars, and are used by the insect to propel itself through the water. It is a most bloodthirsty and fearless insect; it attacks other insects much bigger, and apparently stronger, than itself, and also preys upon its own species.

THE WATER BOATMAN.

Of very great interest is the life-history of the Gnats or Mosquitoes, not only because the early stages are passed in ponds, ditches, and shallow pools, but because some species in the adult stage of their existence are the transmitting agents of certain diseases—malaria and yellow fever among them—to man. The female Mosquito or Gnat lays her eggs in boat or raft shaped masses upon the surface of the pond, and from these eggs come forth quaint-looking little creatures with large heads adorned with tufts of bristles, and with fairly long slender bodies terminating in what looks somewhat like a double tail. They move through the water with rather a jerky, wriggling motion, and from time to time rise to the surface tail first, and stick the curious tail-like process which is attached at right-angles to the general outline of the body, and is called the syphon-tube, out of the water to take in

THE GNAT LARVA RISES TAIL FIRST TO THE SURFACE.

a fresh supply of air; for at this, the larval stage of their existence, they breathe through the curious tail-like organ. They feed chiefly upon the microscopic forms of life that swarm in the pond, but they are also great cannibals, and devour their younger and weaker brethren. They grow fairly rapidly, and from time to time, in consequence of their increasing size, cast their skins. Just before the final larval moult they alter in shape, having a more bulky appearance in the region of the head and chest or thorax, until at last the skin is cast and the change which has been taking place beneath it is revealed. Then the head and chest are seen to be enclosed in a casing resembling in shape a kind of fireman's helmet, the body has shortened, and the double tail has changed to an extremity rather like the tail of a lobster. From the back of the "helmet," near the base of the head, spring two short tubes, and within the semi-transparent covering of the "helmet" can be seen the slender folded legs and wings of the future adult Gnat. The insect has now reached the active nymph stage of its life, and now rises to the surface head first, poking out the two tubes on its back, through which it takes in the air supply.

THE GNAT NYMPH RISES HEAD FIRST TO THE SURFACE.

When the final transformation of the Gnat is about to take place the active

HEAD OF MALE GNAT WITH PLUME-LIKE ANTENNÆ.

HEAD OF FEMALE GNAT WITH LANCET, ETC.

nymph rises to the surface and sticks its back well out of the water. The skin soon dries and cracks, and the perfect insect emerges. It rests for a short time on the old nymph-case, which serves as a raft, until its wings have dried and fully expanded, and then it flies away. Curiously enough, while the male Gnat or Mosquito is quite a harmless, inoffensive creature, and sucks only the juices of plants, the female is a most tormenting

THE GHOST LARVA HAS A FORBIDDING-LOOKING HEAD, BUT—

IS GRACED WITH AN EXQUISITE FAN NEAR THE EXTREMITY OF ITS BODY.

and bloodthirsty insect, greedily sucking the blood of man whenever she can get the opportunity. As might be expected, this diversity of food supply has led to a very considerable modification in the formation of the mouth-parts of the male and female Gnats; the stabbing or piercing lancet of the female is very highly developed. It is the female that is the transmitting agent of disease from man to man; it sucks the blood, for instance, of a man suffering from malaria or yellow fever, as the case may be, and so becomes infected and infective, for it absorbs along with the blood the parasite that causes the disease, and introduces it into the blood system of the next person it bites. The difference in appearance between the antennæ of the male and female Gnat is most striking; those of the male are beautiful plume-like organs, while those of the female are comparatively simple in structure.

The life-history of the *Ephemeridæ*, or Day-flies, is a very curious one, for they are insects which last for the shortest time imaginable in their perfect state. Most fragile and delicate of creatures, they float away in the air from off the water, in which they have lived during the early stages of their existence, to spend the few brief hours of their perfect winged life in graceful airy dancing and active courtship. Truly they are the most ephemeral of creatures!

The perfect insects are easily recognised; they have small heads, with large compound eyes, and short awl-shaped antennæ; the wings are very delicate, the front pair being the largest; the slender body is terminated by two or three long-jointed bristles, and the legs are very slender; the mouth-parts are often quite membranous in texture, for the insect apparently takes no food during the extremely short period of the perfect stage of its existence. The most familiar of the species, the May-fly, is a brown colour, banded with yellow, and has wings of a smoky hue with brown spots. It is a wonderful sight to watch the hundreds of these graceful insects, on an early summer evening, performing

their singularly elegant, dancing flight over a pond or shallow stream, rising and falling with a wonderfully rhythmic motion above the surface of the water.

The female May-flies deposit their eggs in little packets upon the water, and the larvæ on making their escape descend to the bottom of the pond or stream, where they lurk beneath stones, or excavate little burrows furnished with an opening at each end. The larval period lasts for a considerable time, probably two or three years, during which time the insects prey upon other pond larvæ, seizing their victims with the aid of their well-developed, sharp-pointed jaws. They continue to be active during the nymph stage, when the rudiments of the wings are visible. When the nymph is full grown, it crawls up the stem of a plant until it gets above the surface of the pond, and then waits while its skin dries and cracks down the back, and so enables the adult to emerge. But at this stage the creature is not quite perfect; indeed, it is a sort of pseudo-perfect insect, for although able to use its wings for a short flight, all its parts are covered over and entirely enclosed in a very delicate membrane which completely hides the true colouring of the perfect insect. In this condition, the insect flies to some branch or other suitable resting-place, where, after an interval, this delicate membrane is ruptured, and the now perfect May-fly makes its escape and quickly flies away to join in the merry dance of its countless kin.

The *Corethra*, or Ghost larva, to be found in most ponds, is so wonderfully transparent that it can hardly be distinguished from the water in which it swims. It is a long and slender insect, and has a very formidable and forbidding looking head, but is graced with a most exquisite, delicate fan of hairs near the extremity of its body. The perfect Corethra somewhat closely resembles the common Gnat in general appearance, and is a small, brownish insect about a quarter of an inch long.

F. Martin Duncan.

HOW TO KNOW THE WILD ANIMALS

By DOUGLAS ENGLISH, B.A., F.R.P.S.

Author of "Wee Tim'rous Beasties," "Beasties Courageous," etc.

THE BADGER

THE BROCK THE GREY THE EARTH PIG

With Photographs by the Author

THE gardener, whose skill with animals appeals to me even more strongly than his skill with plants, has just brought word that my two Badgers, to wit, Sally and Jemima, have totally disappeared. Sally and Jemima live in a derelict green-house—from which a three feet climb would free them. But Sally and Jemima are of the earth, earthy. Now and again they rear full stretch and file their claws on the brickwork. With this their climbing ends. The heights hold out no promise. Their green-house is paved, or, rather, was paved, with slabs of pottery; Roman in origin, I fancy, for at the last desecration of our local "villa" their counterparts were much in evidence. On the top of these slabs are bricks, piled with design to stack the corners. In driving slants Sally and Jemima greatly affect the corners; wherefore I have arranged that before they reach the tiles they must shift their tale of bricks. The weather governs these occasions, but, when the fit seizes them, the task seems easy enough. I have seen Sally with her head buried, and the bricks (good honest

bricks) flying like leaves behind her. Jemima must needs join in, but a heave from Sally's shoulders catches her and she flies headlong with the bricks, somersaults completely, and lands upon her broad grey back. Jemima's weight is wards. You hear a snuffling, stifled grunt—Jemima's protest. The lorry lumbers past. Five minutes, and they reappear. "Idiot!" says Jemima, as plain as Badger's grunt can speak. But Sally's head is buried in the milk-bowl.

BADGER.

The stripiness of a Badger's coat is due to the fact that each of the long hairs is alternately banded from the root upwards, whitish, brown, black, brown, whitish again.

five-and-twenty pounds. Sometimes her help is welcomed, the bricks are scattered by joint effort, the slabs are wrenched asunder, and, snuffling with ecstasy, the pair of them reach Mother Earth. To vanish, then, is child's play, but, vanish whither they may, their course is limited. On all sides of them are ancient foundations proof even against a Badger's strength. At supper-time they reappear, dusty, shame-faced, and ravenous. Sally comes up first, pauses with fore feet tautened on the brink, snuffs at the air and listens. That sleep with Mother Earth has brought back memories. Last night the lorry might have clanked itself to pieces, but now the first faint creak of it (a furlong down the road) means instant pressing danger. She tumbles headlong back- Jemima joins her, and, with much fuss, they drain it. Then to stretch their limbs. Nothing like "follow-my-leader" for this. It is Jemima's lead. She starts at a "low trot," head bent to earth, tail dropt, her fore feet criss-cross. These strike the ground flat-soled, her hind feet merely tiptoe; so her back sways and dances. Behind her trots her sister, pace for pace. Jemima wheels sharp right, instantly Sally follows. Jemima stops short, Sally even shorter. Jemima prances, Sally prances too. Jemima lifts her head up, Sally does the same. Jemima ducks her head and gallops to cover, Sally gallops after her

It was I who startled them—with a careless swing of the lantern. There is only cover for one, for I have already

HOMEWARD BOUND.

It will be seen from this photograph that the black and white coloration of a Badger's head is extremely conspicuous under dull conditions of lighting. In theory it should be protective; in fact it is the first thing to catch the eye.

blocked the hole. Jemima promptly takes possession. Sally gives two powerful scrapes, and, heaving her bodily out of it, takes her place. Jemima gains her feet again and promptly returns the compliment. The air is thick with Badgers. Presently, however, they realise that it is only me, and venture out together side by side. This time I step between them. Sally goes right, Jemima left, both hug the wall, and, as neither will give way, collide on meeting. One or the other is cannoned outwards. Recovering, she takes her place in rear. So does their going revert to decency and due order.

This tendency to mimicry is a remarkable phenomenon in animals who, though unquestionably social in character, are not normally gregarious. Nor is the mimicry confined to movement. I have often found Sally and Jemima sleeping in a close embrace, stomachs upward, tails parallel, feet upturned symmetrically.

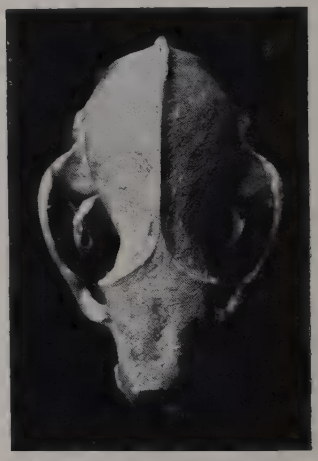
The Badger, whether we consider his ancient lineage, his strength of character, or his strength of frame, whether we concern ourselves with the actualities of his structure, or the mysteries of his existence, is the most interesting animal in the country. So far as lineage is concerned, it will be sufficient for our present purpose to recall the opinion of Owen that the Badger is "the oldest known species of mammal now living on the face of the earth."

Though placed originally by Linnæus among the Bears, the Badger is considered by modern systematists to be closely allied to the Weasels. If one was entitled to judge by character and external features, there would certainly be much evidence in favour of the older classification. In studying the Badger one misses the long flexible neck, the alert sparkling eye, the truculence of expression, and the quickness of movement which characterise the Weasel tribe; one is impressed rather by the bumping, criss-cross gait, the broad, shaggy back, the wedge-shaped head, and the apologetic tail.

These are ursine qualities. Bearish, too, are his modes of feeding—"gug and gumble and slobber"—his abandoned poses in sleep, his taste for sweets and stickiness, his slowness to wrath, his dogged courage, and his deep-toned warning growl.

It is possible that the ancestors of our modern European animals had of necessity to adapt themselves to greater variations of seasonal temperature than those which obtain at the present day. That a well-marked annual cycle still occurs in the case of the Badger is unquestionable. Midsummer finds him in the plenitude of his powers, a strong,

A SIDE VIEW OF A BADGER'S SKULL.



B UPPER SURFACE OF SAME.

In *A* some of the teeth in the upper-jaw are missing. The small size of the premolar immediately behind the large canine in the under-jaw should be noticed. The gape of the jaws is the widest possible, the mandibles (under-jaw) having been allowed to hang free from their hinged articulation (*see* p. 679).
In *B* the enormous development of the central bony ridge, two and a half inches long in this case, and at its hinder end about a quarter of an inch high, and a quarter of an inch thick, suggests not only the solidity and strength of the attached head muscles, but also from a defensive standpoint the origin of the morion.

active, vivacious animal, who starts from his burrow before dark ("set" and "earth" are the sporting terms for a Badger's excavations, "set" perhaps the more sporting of the two), often wanders some miles afield, and does not dream of going home till morning. This is the pairing season—and the season of high living. Badgers eat almost anything — beetles in all stages, honey, bee and wasp grubs, young moles, young rabbits, and small vertebrates in general, grass, bulbs, leaves, and roots. Miss Maud Haviland, to whom I am much indebted both for corroboration of my own notes on Badgers, and for permission to quote some interesting and original observations of her own, tells me of a remarkable fondness which they have for arum roots. Though the arum root under judicious treatment becomes the "Portland Sago" of commerce, the human being who essays to sample raw any portion of this plant will regret his temerity. Its poison, even in very minute doses, has a paralysing effect on the tongue and throat, which endures for a considerable time. The immunity which many animals enjoy in respect of certain vegetable, and even mineral poisons, whose action is dangerous in the case of human beings, is extremely curious, and would well repay investigation.

THE ARTICULATION OF THE BADGER'S MANDIBLE.

A. The condyle fitting into the glenoid cavity.
B. The coronoid process of the mandible.
C. The angular process.
The transverse measurement of the condyle is about seven-eighths of an inch, and the articulation admits of an up and down movement of the lower jaw through about 40 degrees, and a lateral displacement through about an eighth of an inch. The front border of the glenoid cavity overlaps the condyle on the outer half, and the hind border (not visible in the picture) on the inner half. Dislocation without fracture is impossible.

Towards the September equinox Badgers thoroughly clean out and relitter their burrows. I have never been fortunate enough to witness this operation, and I am again indebted to Miss Haviland, who in a recent letter to me describes the process as follows: "They twist up moss and dead grass in balls, and drag it in quantities into the burrow, so that a glade where they have been harvesting looks as if a herd of pigs had been rooting there. I have known a case where the distance from the collecting ground to the hole was about two hundred yards, through dense laurels down a hill side. They always drop a great deal on the way, and the nest takes about a week to make. I have put straw or shavings at the mouth of the burrow, and they have always taken it in if it is dry, but not otherwise. Once I made fast a string to a bundle of hay and pulled it up after they had taken the hay down. They had run out about fourteen yards of string—but that is not long for an earth. There is one on the Courtown Estate (Co. Wexford) which is at least a hundred yards long, but I suspect that this is connected with an old drain. At one time all the Badgers at Courtown were exterminated, but in a few years the burrows were again occupied. Nine Badgers were killed on one estate in Kilkenny in 1907. They used to be very common there, and on one occasion one of the family looked out of the window at midnight and saw three Badgers just outside the hall door. They used to dig up any crocus, tulip, and snowdrop bulbs which were planted round the house, but they never touched daffodil, bluebell, or hyacinth. I think that the slimy juice in the latter's shoots deterred them."

The fresh nest which Badgers construct in September is designed for winter quarters. As the cold approaches Badgers get more and more sluggish, leave their burrows later, and return to them earlier, until, by the time mid-winter is reached, they will often remain without food for days, and are only tempted out by extremely genial and unseasonable conditions. From mid-winter onwards

RECONNOITRING.

they gradually resume their activity, and at about the March equinox they have a complete spring-cleaning and a second re-littering of their nests. This is in anticipation of the arrival of the cubs. The normal gestation of the Badger is about seven months. It is probable that the cubs are weaned at about six weeks, and so the parents come back to the pairing season once more (barring accident Badgers pair for life), and the annual cycle recommences.

In an animal whose burrowing power is so remarkable (in almost every district where Badgers are plentiful there are traditions of vast subterranean galleries extending a mile or more and reaching a depth of at least a hundred feet), whose enormous strength is combined in most cases with gentleness and extreme shyness, and whose persistence as an unaltered type from very early times is generally admitted, one expects naturally to find unique peculiarities of structure. I will leave my photographs to give a general idea of the Badger's coloration, and of the extraordinary articulations of his mandibles, which remain locked to the skull even after the powerful muscles and ligaments which control them have been completely removed. It is evident that with an arrangement of this kind the jaws cannot be dislocated without fracture, and that, when once a Badger has got his teeth home, it will be extremely difficult to make him loose his hold. Sir Alfred Pease, in his excellent little book on the Badger—to which I would refer my readers for an entertaining and well-written account of the animal from a sporting as well as from a zoological aspect—gives the following gruesome instance of this power of grip: "The Badger held him (a keeper) by the wrist for ten minutes with his arm stretched up the hole; when he let go his hold the hand was hanging by a few shreds, and had, of course, to be amputated." A man's wrist crosswise in a Badger's mouth would be an object of just the right proportions to get full work out of the specialised jaw mechanism, and the laceration would of course be increased by the man's endeavours to free himself.

With the note that the abnormality of the extensor muscles of a Badger's fore-limb was held by Cuvier to augment greatly its power as a digging tool (a Badger's fore feet, besides possessing larger claws, are in themselves consider-

GOING OUT.

ably larger than his hind feet), we may pass to a short consideration of the extraordinary glands situated beneath the root of his tail. I may say at once that the proverb "to stink like a Badger" is, like most proverbs derogatory to animals, a gross perversion of fact. A Badger kept under reasonably fair conditions is as clean and sweet an animal as exists. It is probable that the proverb had its origin in the bestial custom of Badger-baiting, which implied keeping the animal in a barrel or in similarly confined quarters until there was a sufficient entry of dogs to pay the publican. The functions of a Badger's subcaudal glands have been ably investigated by Professor Herbst of Göttingen, and I entirely agree with his conclusions that whatever their use may be in the mature Badger, the immature Badger regards their secretion as a condiment and possibly as a nutriment. The continual attention which baby Badgers pay to this portion of their anatomy cannot fail to strike anyone who is fortunate enough to have experience of baby Badgers, and though mature Badgers are inclined to seek similar consolation by sucking their thumbs for hours together, they are by no means averse to directing their muzzles elsewhere. It must not be forgotten, however, that portions of the body which continually exude viscous matter are continually in need of cleaning, and that the application of a mature Badger's tongue to his subcaudal glands may be analogous to the application of the handkerchief to the human nose.

DOUGLAS ENGLISH.

HOW TO KNOW THE TREES GROWING IN BRITAIN

With Notes, descriptive and photographic, for their Identification in all Seasons of the Year

By HENRY IRVING

THE ELDER, THE HOLLY, THE LABURNUM AND THE ACACIA

THE ELDER

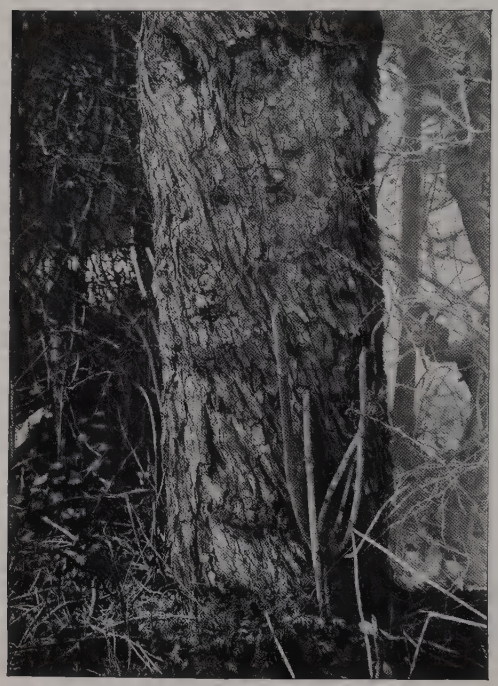
THOUGH generally seen growing as a somewhat straggling bush, the Elder not infrequently becomes a small standard tree. It is common in all the countryside, but it seems to have a special preference for the neighbourhood of human habitations. This may be due to the regard in which it has been held as the possessor of certain medicinal and other virtues. It may be due to use and custom, but it always seems to strike a homely note in our landscape, and, whether seen in full flower or in berry, it wins a kindly notice.

Its habit of branching is very distinctive. As a rule several stems rise from the base, and these bend over, drooping at the tips. Along these, especially at the supreme curve, rise other upright stems, which likewise bend over. Many similar shoots also rise upright from lower down on the main stems, at short distances apart, like whipstocks. The branching, besides being irregular and straggling, has the appearance of cross-hatching, and is in parts overcrowded.

The bark, with age, becomes rough and deeply furrowed; its colour is a yellowish brown. The twigs are a pale greenish grey marked with distinct patches of yellowish brown, indicating the presence of numerous breathing apertures. Twigs

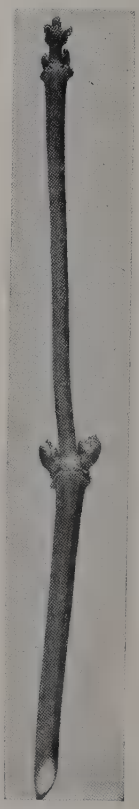
and shoots have but a thin outer woody coating, all within being soft pith. The buds are arranged upon these in opposite pairs. They have a few loose scales at the base, above which the tips of the young leaves are seen as green unprotected tufts throughout the winter.

The leaves are compound, made up of



TRUNK AND BARK OF ELDER.

from two to five pairs of leaflets with a single terminal one. These leaflets are oval and pointed, having their margins rather coarsely toothed. The flowers are individually small, with five creamy white petals. They are made conspicuous by their grouping into a rounded flat extension, which suggests a platter upheld on a five-branched support. They secrete no nectar, but are much visited for their pollen by many kinds of flies, to whom their rather disagreeable scent is evidently an attraction. The fruit, upheld in the same way, and grouped as the flowers, takes the form of a stone fruit, small, round, having three stones embedded in its juicy pulp. It is eagerly swallowed by numbers of small birds, and in this way its contained seeds are effectively dispersed.



ELDER TWIG.

THE HOLLY

The Holly can never be mistaken, whether met with as hedge, bush or tree. Its use in our Christmas decorations has assured that. It may be found by almost every wayside, and is often abundant as woodland undergrowth. It is most distinctive when other trees are bare of leaves, but not only for the fact that its leaves remain. Its ripe, red, coral-like berries, crowded on the twigs amongst its rich green, varnished foliage, render it conspicuous at this season, spreading a rich glow of colour in striking contrast to the wintry surroundings.

The bark is smooth, ashen grey in colour, recalling that of the beech. The leaves, dark green and polished, thick in substance, hard and leathery in texture, are typical ever-

ELDER LEAVES.

ELDER.

LABURNUM.

TRUNK AND BARK OF HOLLY.

green leaves, adapted to withstand and endure stress of winter. Their margins are plentifully armed with sharp spines, and as the leaves are spirally arranged on the twigs, and moreover as each leaf-blade curls and twists, these sharp points are presented in every direction, thus affording a sure protection against browsing cattle. They are, however, no defence against cropping by deer. There is a noticeable tendency to forego this defence on the higher branches, where the necessity for it is lessened by their being out of reach. This cannot, from the evidence afforded by our native Hollies, be defined as more than a tendency. The leaves, according to Dr. Groom, remain attached for about four years.

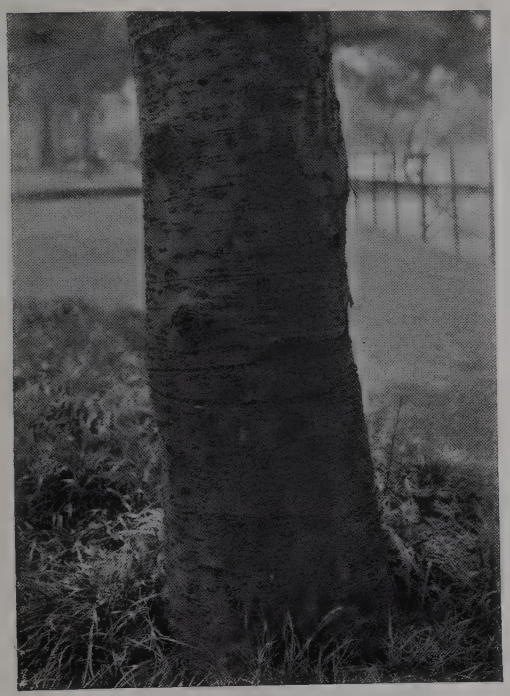
The small flowers, having four creamy petals, are crowded together at the base of the previous year's leaf-stalks. They are, as a rule, incomplete, having only rudimentary stamens or pistil, but the flowers on each tree are usually in agreement. In consequence of this some trees display no winter crop of berries. The fruit, however, is not a berry. It is a stone fruit with four stones. As the bright colour and pulpy substance of the fruit would lead us to expect, the seeds in their hard shells are dependent upon the birds for their dispersal.

THE LABURNUM

The pea-pod tribe of plants is one of the most extensive. It includes, amongst herbs, the peas and beans, the vetches, the clovers, and many others ; amongst shrubs, the broom and

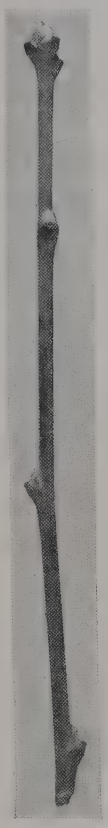
HEDGEROW HOLLY.

gorse, and amongst trees the Laburnum and Garden Acacia. It is not only distinguished by its fruit, but also by its flowers. These, with modifications, may be described as having wing-like petals, suggestive of a butterfly's wings, and boat-like petals, which by the union of two constitute a very fair representation of a boat's keel. An examination of these flowers, and comparison of one kind with another, are of special interest as showing the various adaptations and devices by which their fertilisation by insects is governed and accomplished.



TRUNK AND BARK OF LABURNUM.

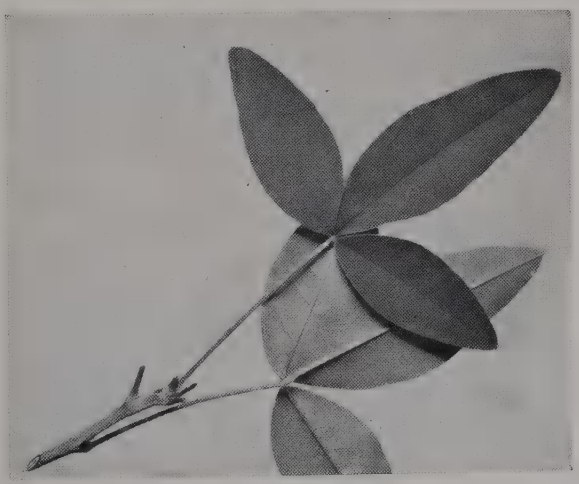
The Laburnum, so common as a small tree in gardens, can never be mistaken when in bloom. Its branches, curving with the weight of their drooping yellow tassels, suggestive of "golden rain," make it familiar and a favourite. It is not a native tree, but it is completely naturalised. Yet it is seldom, if ever, found growing wild. This is the more remarkable from the fact that its seeds readily germinate, and its seedlings spring up freely as garden weeds. A suggested explanation is that, in the open, these seedlings never escape the attention of the rabbits, to whom they prove a dainty morsel.



LABURNUM TWIG.

The bark is smooth, eventually peeling off in transverse strips. The twigs are green, becoming greyish as their outer skin flakes off. The buds are arranged spirally on the twigs. They have three scales, and are coated with silky hairs. The leaves are compound, having three leaflets. These are elliptical in shape, and without marginal teeth. Their under surface is pale and silky. They are attached by very short stalks to the end of a long main stalk, but as dwarf shoots are very numerous the leaves usually appear tufted.

The flowers are congregated in the form of clustered tassels. These droop gracefully, but each individual flower, when expanded, stands out horizontally

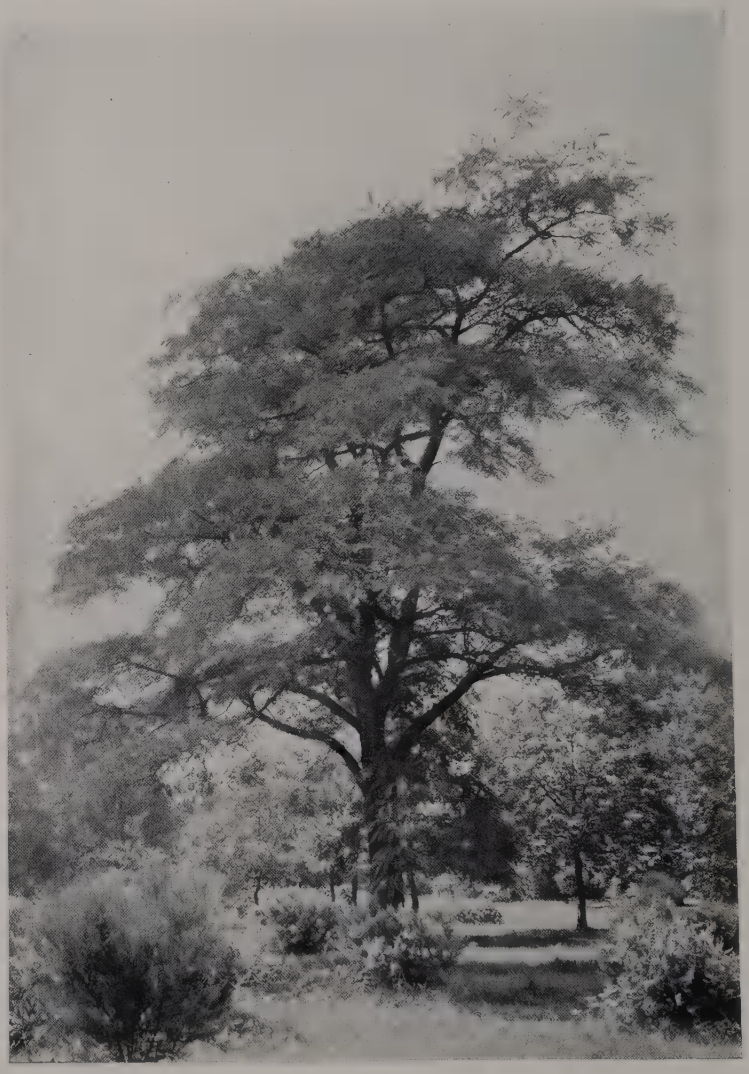


LABURNUM LEAVES.

in a manner best suited to a bee's alighting. Their colour is a golden yellow, but in one variety they are pink or purple. Two dark lines on the upright petals serve as guides to the concealed nectar. The fruit is in the form of a yellow or brown pod. Several of these are attached to a single stalk, and several stalks form a cluster, which remains on the tree all through the winter. When ripe the pod opens, splitting lengthwise, and the black seeds escape.

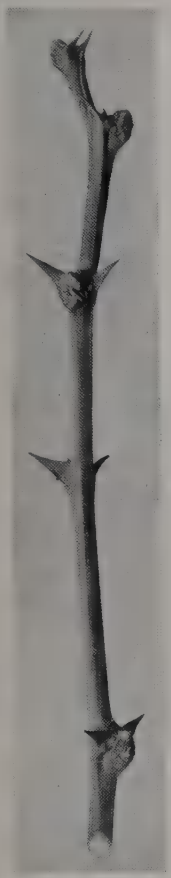
THE ACACIA

This ornamental and interesting tree is sadly in need of a name. As the result of one error it has been named Acacia, and of another Locust Tree. Botanists speak of it as False Acacia, which is simply libellous. Acacia "falsely so called" would be more correct. White Laburnum is misleading, and Garden (or Gardener's) Acacia is almost equally so.



ACACIA.

A considerably larger tree than the



ACACIA TWIG.

Laburnum, it has much in common, particularly in respect of its flowers and fruits. The bark, which is brown in colour, becomes deeply furrowed and uneven, having raised ridges forming a lattice-like pattern. The twigs are olive to brown. The buds, arranged spirally, are entirely hidden in a large angular leaf-scar which lies between two projecting spines. The compound leaves consist of from five to twelve pairs of leaflets with a terminal one. These are oval in shape and without marginal teeth. They are thin in substance, smooth in texture, of a bright green above, bluish below. Like the leaves of the Laburnum, the clovers, and some other plants of this order, they close one over another, and become pendent at night, suggestive of sleeping. The purpose of this is to lessen transpiration and consequent chilling.

The flowers are white, fragrant, and hang in pendent tassels, after the manner of those of the Laburnum. They provide abundance of nectar. Some varieties have yellow, and others rose-coloured, flowers. The fruits are dark red flattened pods, containing six or more seeds.

HENRY IRVING.

TRUNK AND BARK OF ACACIA.

ACACIA LEAVES.

THE STORY OF THE MOULDS

By JOHN J. WARD, F.E.S.

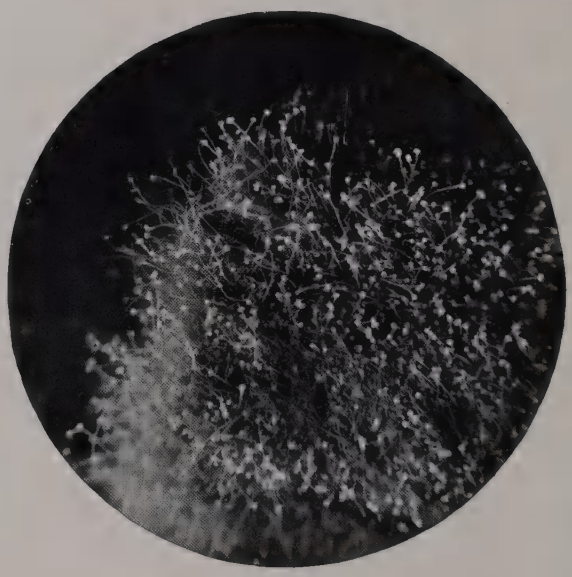
Author of "Life Histories of Familiar Plants," "Some Nature Biographies," etc.

With Photo-micrographs by the Author

THE mysterious, fluffy growths known as "moulds" are familiar intruders in every household. They readily attack such food materials as jam, cheese, bread, pickles, ripe fruit, etc., and on these substances they flourish amazingly, as every housewife well knows; likewise, old boots, paste, wall-papers, books, and many other household commodities offer them suitable quarters.

Most persons are very much surprised when they first learn that each little fluffy mould patch that appears upon their food, or other materials, is, in reality, a dense, miniature forest; yet such is the case. It is true that the tiny plants that inhabit these forests are not altogether analogous to those with which we are familiar in our woodland rambles. To make the analogy complete we should have to reconstruct the scene somewhat.

Let us imagine that all the elm, oak, fir, and other large forest trees were felled, and that those weird-looking fungi that stand out boldly in the moist corners of the wood then spread themselves all over the land and occupied the place of the trees, and at the same time grew to the same height as the trees. Then we should have a mammoth mould forest; for moulds are but minute mushrooms or other fungi of proportionately tall growth.

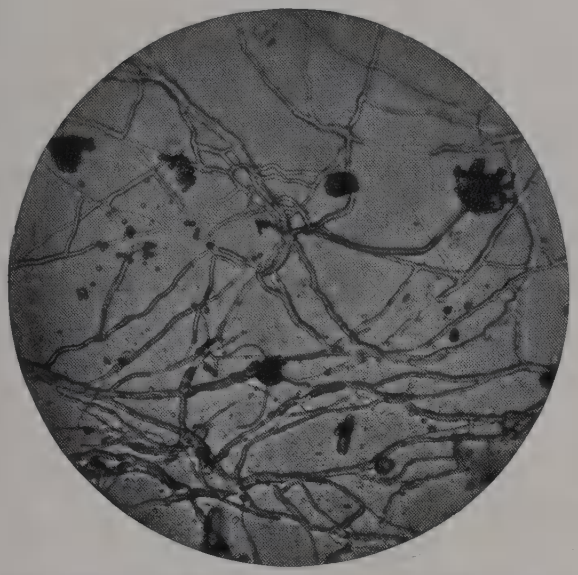


A MOULD FOREST GROWING ON JAM.
(Magnified 20 diameters.)

Those readers of THE NATURE BOOK who possess a microscope of low power may, by aid of that instrument, peep into the depths of these mould forests. In the illustration on this page I have shown a bird's-eye view, as it were, of the corner of one of these forests flourishing on the surface of a pot of jam, as it appears when magnified 20 diameters.

Below it is seen to be a dense carpet of felt-like growth, while springing from this are innumerable tall filaments bearing large and conspicuous heads. This felt-like growth is the vegetative part of the fungus, corresponding to the branches and roots of other plants, according as they remain above or penetrate the surface on which they are developing; while the tall filaments with the conspicuous heads may be likened to the flowering branches of other plants.

Fungi, however, are entirely devoid of the roots, stems, leaves, and flowers so characteristic of familiar plants; neither



THE MOULD PLANT EXTENDING ITS BRANCHES WHICH GIVE ORIGIN TO THE SPORE-BEARING PARTS.
(Magnified 100 diameters.)

do they produce seed. The "seed" in the case of fungi is termed a spore.

Immediately the minute spore reaches some suitable substance on which it can develop, it commences to send out a delicate, thread-like structure termed a *hypha,* which grows rapidly, forming branches which permeate in all directions the substance on which it is growing, as shown above. The *hyphæ* extend so quickly that in the course of a few days they begin to form the thick felt-like growth previously referred to, which is called the *mycelium.*

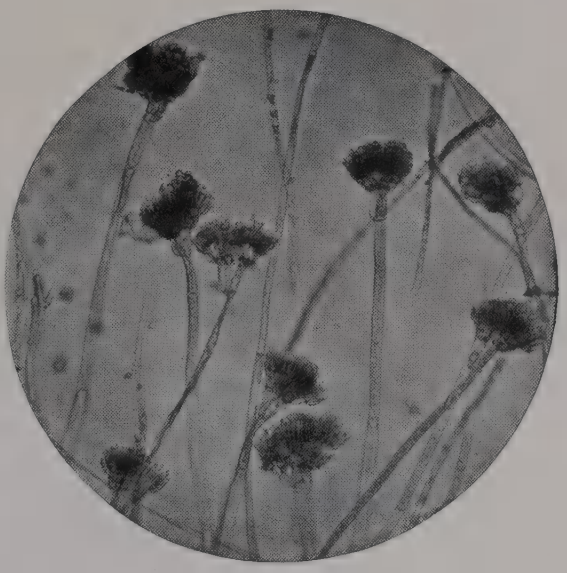
From the *mycelium* there then appear numerous *aerial hyphæ;* and eventually these produce at their summits the apparent flowers. These structures, however, when ripe, are seen to consist of numerous short branches crowded together in brush-like heads; each little branch as it develops becoming a row of rounded spores. In the lower illustration on this page are shown some of these heads magnified 130 diameters.

The whole structure of these mould plants is very simple; the *hyphæ* are composed of long tube-like cells filled with protoplasm, or living matter; there is none of the complex and specialised cell-structure such as we are familiar with in all parts of the higher plants. The structure of these lowly organisms is much the same throughout; their "roots," "branches," and spore-bearing parts all bear a structural likeness; even the rows of spores are but branches of the *hyphæ* divided into minute bead-like constrictions.

Structurally considered, they only differ from the lowest of known plants (whose structures are homogeneous throughout, and often consist of only a single cell) in the fact that the plant body is divided into distinct vegetative and reproductive parts.

It is only in a few species that anything of the nature of sexual reproduction is known, and that aspect of the subject need not concern us here. The non-sexual method of reproduction we may however, now consider, for it is by that means that these lowly fungi are so largely propagated upon food and other materials.

From the innumerable spore-bearing

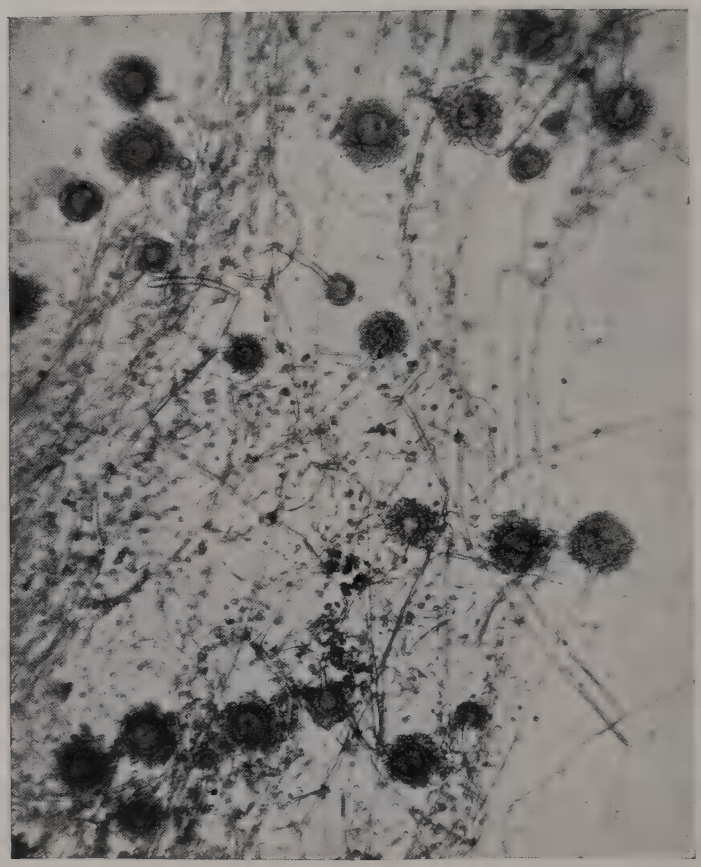


SOME OF THE HEADS OF SPORES SHOWN IN THE ILLUSTRATION ON PAGE 688.
(Magnified 130 diameters.)

heads come myriads of ripe spores, and so minute and light are these non-sexual spores (which, as I have previously explained, are but minute constrictions of the reproductive branches of the

examples of similar but more malignant organisms.

When, however, the spores that float in the atmosphere settle upon an exposed article of food or some moist organic



BLUE MOULD ON CHEESE.
(Magnified 60 diameters.)

hyphæ) that they are removed from the spore-heads by the slightest breath of air. The air we breathe often contains large numbers of such tiny spores ; thus the smell of mouldiness is a sufficient indication to us that, in all probability, we have inhaled several hundreds of these invisible mould germs. Usually, when thus disposed of, they do little or no harm, but the germs of some other lowly fungi may, on the contrary, be extremely mischievous ; the microbes or bacteria that produce disease in man and domestic animals are

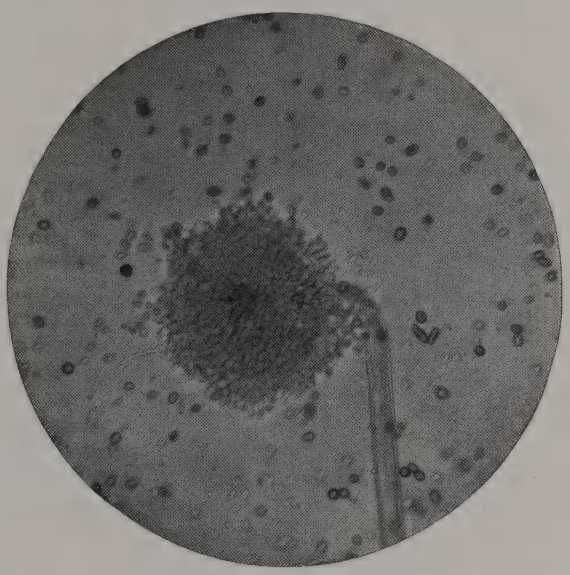
product, such as I have previously mentioned, they at once commence to germinate and spread their *hyphæ* through the substance ; and so, in a few days, another mould forest is produced, from which millions of spores arise and are wafted into the atmosphere.

These fungi being parasitic on decaying organic matter, naturally flourish on such materials as jam, pickles, cheese, bread, etc., for such materials are but decaying substances. Whenever in our methods of food preservation a weak spot, due to souring or fermentation,

arises, we may know that fungi or bacteria have made their appearance. A piece of cheese, that is apparently quite sound one day, may on the next develop a mould-covered surface that hourly waxes larger. The explanation is, of course, that the substance of the cheese has reached that stage of ripeness where decay or a dissolution of its chemical equilibrium sets in, and this state gives opportunity for the germination of the mould spore. Hence the necessity for refrigerating or canning articles of food as a means for their preservation. The importance of carrying out methods of preservation in a thorough manner cannot be too much insisted on; the slightest opportunity of attack is immediately seized upon by the enemy.

On page 690 is shown some of the familiar Blue Mould (*Aspergillus*) that develops on cheese magnified 60 diameters. In this photograph the *hyphæ* and the spore-bearing branches are clearly seen, and also we observe that innumerable spores are being scattered in all directions. Now I will ask my reader to imagine what happens when the cheese-dish is brought to the table and the cover removed.

The piece of cheese included in this photograph is scarcely larger than a pin's head, yet numerous spore-heads appear; on the whole surface of the cheese upon the dish, however, there may be many thousands of spore-heads. Immediately the dish-cover is removed, the inrush of air causes every ripe head to burst and scatter its spores. In the illustration on this page I have photographed one of the ripe heads in the act of scattering its spores under a magnification of 200 diameters, or, more popularly speaking, 40,000 times; probably this picture will explain better than a volume of words how these tiny germs may infest an atmosphere. It is obvious that the air at once becomes loaded with spores, each of which may be the parent of another mould forest.



ONE OF THE RIPE SPORE-HEADS SEEN IN THE ILLUSTRATION ON PAGE 690.

Photographed in the act of scattering its spores into the atmosphere. (Magnified 200 diameters.)

In the last picture another mould species is shown, a form that frequently grows upon moist bread or paste. It will be seen, therefore, that these minute fungi differ in form just as do their larger relatives the more familiar toadstools and mushrooms. It is the *mycelium* of the mushroom that constitutes the "spawn" used for mushroom propagation, while the mushroom itself is an agglomeration of the spore-bearing branches or *aerial hyphæ*, such as we have glanced at in the delicate moulds.

Unfortunately, the depredations of these minute and lowly organisms extend far beyond our food materials and household commodities. There are numerous forms that attack and thrive upon living plants, eventually bringing about their destruction; indeed, it is probable that every living plant has some species of mould or fungus that preys upon it; some unfortunate plant hosts are victims to quite a large number of such enemies.

When the gardener looks grave and talks of mildew, rot, canker, scab, smut, bunt, leaf-curl, leaf-blotch, fungus disease, etc., we may know that the minute but destructive fungi we popularly term

"moulds" have been destroying his produce.

Sometimes, in agricultural districts, whole crops of grain and fruit are completely ruined by these pests; indeed, where a particularly virulent species gets the upper hand, it often means that vast areas of land are completely devastated;

A MOULD THAT GROWS ON OVER-RIPE FRUIT, BREAD, ETC
(Magnified 60 diameters.)

desolated vineyards and famine frequently being the outcome of its destructive work. Vine mildew, potato disease, onion mildew, American gooseberry mildew, etc., are foes of this order, all greatly dreaded by the agriculturist.

I have previously stated that every plant probably has its fungus parasite; it is remarkable, however, that the familiar mushroom, and various toadstools, should suffer from parasitism of the same class. Cultivated mushrooms are often attacked by a minute mould or fungus (*Hypomyces perniciosus*) that distorts the spore-bearing parts (*i.e.* the mushroom) until they become swollen and diseased masses. Such parasitism is analogous to that which inspired the poet who penned the famous lines:

> "Little fleas have smaller fleas
> Upon their backs to bite 'em,"

and, seeing that eventually these secondary parasites themselves become the prey of still more simple fungi (bacteria), we may add the remainder of the poet's verse:

> "And these again have lesser fleas,
> And so *ad infinitum*."

for where such parasitism ends it is difficult to say.

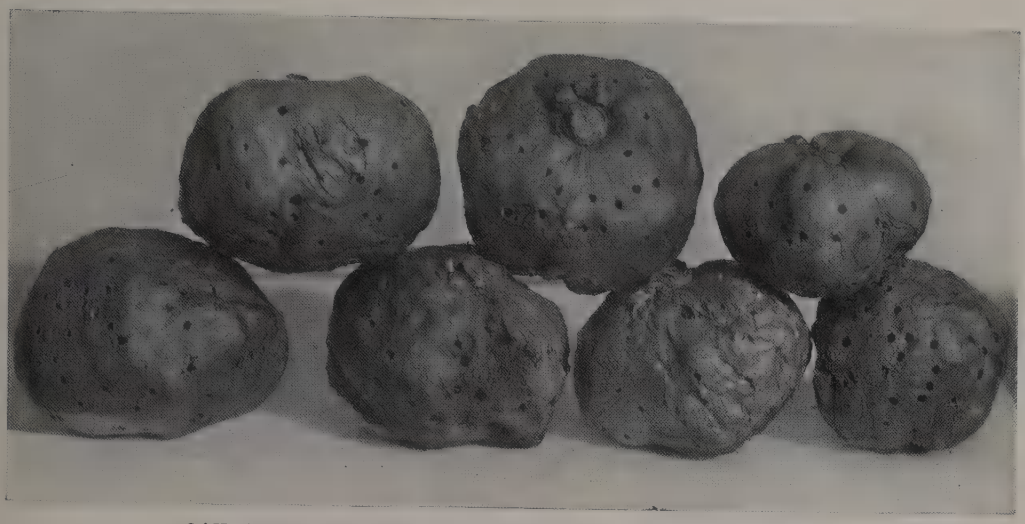
In the same manner animal life is equally open to attack by these imps of mischief. Man and domestic animals suffer from innumerable diseases entirely due to these lowly organisms; hence it is the aim of modern surgery, in the dressing of wounds, in operations, etc., to prevent access to bacterial germs (which are moulds reduced to their lowest terms), and by the use of antiseptics to destroy their virulent properties.

While these minute fungi are bad masters, they, nevertheless, may become very good servants. By their orderly working we are enabled to prepare many valuable food materials, such as bread, beer, wine, vinegar, cheese, etc.; while others of their kind, by their united action, are continually renewing the fertility of the soil. Even in their most destructive moments they are carrying out a useful function in Nature's economy; although, I fear, it would be difficult to persuade the farmer thus far who has lost a valuable crop by their baleful agency. Nevertheless, Nature is clearing off her score. The spore of the vine mould cannot penetrate the tough skin of the perfect and healthy grape; not until it ripens and turns soft, as decay is approaching, can it make an attack; likewise, the weak and badly cultivated crop is always open to receive the enemy, for Nature abhors the weakling, and is ever ready to lay it low. The lowly fungi constitute the scythe by means of which she cuts it down; only, though, to reconvert its dead and putrefying substance into new and more perfect life forms. The fungi are Nature's scavengers that sweep her garden path and keep her house in order.

JOHN J. WARD.

SPRINGTIME.

From the Painting by A. C. Wyatt, in the possession of Sir Laurence Gomme.



OAK APPLES IN AUTUMN AFTER FALLING FROM THE TREES,
Showing holes through which the flies emerged in June.

WHAT IS AN "OAK APPLE"?

By HAROLD BASTIN

With Photographs by the Author

VEGETABLE galls are among the most familiar objects of the countryside, yet most people have a very hazy idea as to their origin and significance. Certain kinds were—and, indeed, are still—thought to be a queer kind of fruit; witness the popular name "oak apple." Another commonly accepted but erroneous theory with regard to other galls is that they are a fungoid growth. As a matter of fact, galls are a part and parcel of the plant on which they are found, albeit a morbid growth, and are generally the outcome of irritation caused by insects. Some well-known galls, such as the variously coloured "nail galls" on the leaves of the lime, and the red, globular galls on those of the maple, are due to the activity of mites—minute creatures more nearly related to spiders than to insects. It is, however, with an insect gall that I propose to deal; to trace, in fact, the "life history" of that familiar object—the common oak apple.

Everybody knows the oak apple, or "King Charlie's apple," which is sported as a buttonhole by country lads on "shig-shag" day. Yet it will probably come as a surprise to many to be told that these pretty, fruit-like objects are really the nurseries of certain minute four-winged flies related distantly to our bees and wasps. Such, however, is the fact; and to prove it one need only keep an oak apple, which has become "ripe" and brown, for a few weeks beneath an inverted tumbler. In due course the flies will make their appearance, burrowing through the substance of the gall.

To trace the complete life cycle of the oak apple gall insects, however, it will be necessary for us to begin by carrying our minds back to the dull, cold days of midwinter. For strange to say, and contrary

to the common custom of insect life, the insect which originates the oak apple is abroad and active about Christmas time. By patient search she may be found creeping upward upon the twigs of oak trees. In appearance she is not unlike a small ant. She has no wings, and

AGAMIC FEMALE OF OAK APPLE INSECT
Ascending oak twig to oviposit in terminal bud.

must thus accomplish all her journeyings afoot.

Let us follow in imagination the doings of this intrepid insect. She makes her way to one of the buds of the oak tree—usually selecting a terminal bud—and climbs upon it. She is equipped with a long ovipositor, or egg tube; and by means of this instrument she is about to anticipate the course of the springtime which she is destined never to know. Cleverly she inserts her ovipositor between the closely wrapped bud scales. She is too wise to attempt the futile task of boring through the substance of the scales themselves; but by searching out a weak spot in the armour of the bud, at a point where the scales overlap, she is able to thrust her egg tube right down among the tightly packed baby leaves which lie snugly waiting for the call of the springtime to rouse them from their slumbers.

What follows is soon told. Down her long ovipositor the fly passes her eggs, one by one, and thus lays them without difficulty right within the bud, at the base of the young leaves. When she has inserted as many eggs as she deems the bud will support, she withdraws her ovipositor, and crawls to another bud. This she also inoculates; and so on, until her store of eggs is exhausted. Finally, her labours over, she dies, having performed the office by virtue of which she holds a place in the economy of Nature.

I need hardly say that to discover one of these inoculated oak buds is by no means an easy matter. The task may almost be likened to the search for the proverbial needle in a haystack! But by dint of perseverance—carefully splitting one terminal oak bud after another, and

examining the contents of each with a magnifying glass—I had the good fortune to discover a mass of the transparent, pear-shaped eggs of the fly in one of them. The photograph of this bud, with the eggs *in situ*, appears on this page. It has not been touched up in any way; thus the reader may see for himself that the gall-fly really lays her eggs right down in the heart of the bud.

Now all these buds which contain eggs bring forth oak apples in the springtime; and within these oak apples the young grubs that hatch from the eggs are nourished upon the sap which, strictly speaking, is provided by the tree for the development of its leaves. But how is this thing brought about? In what manner does the gall insect contrive to make the tree provide food and shelter for its offspring? These questions have puzzled naturalists almost as long as naturalists have existed to be puzzled. Pliny thought that galls were fungi, and that the flies were bred in them by chance. A later author said that the parent insect laid its eggs in the ground, whence they were drawn up by the sap to the leaves where the galls were found. Still another writer put forward the rather obscure theory that "the plant had a vegetable soul, this vegetable soul presiding at the origin of galls, with their eggs, larvæ and imagines, while it again gave issue to fruits." A more modern notion, and one which until recently received universal acceptance, was that the parent insect infected the plant tissue during egg-laying—injecting a minute drop of peculiarly poisonous fluid, and that this poison caused the rapid enlargement and subdivision of the vegetable cells affected by it, so as to form the tissue of a gall.

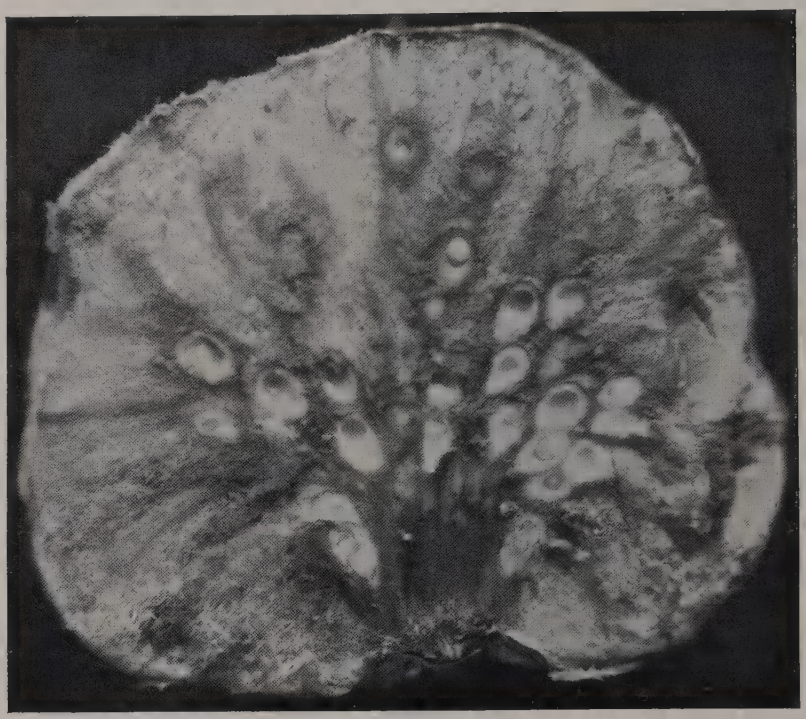
Without going into detail, it may be said that this theory—despite its plausibility—does not correctly solve the problem of gall formation. Scientific observers have found that although the gall wasps actually inject a drop of fluid into the wound which they make in the buds, they do this either to provide a lubricant for the working of their ovipositor, or as a varnish to seal up the injury—certainly not to poison the tissue.

How, then, are we to account for the formation of galls? Probably the irritation set up by the presence of the eggs, and subsequently by the gnawing of the tiny grubs, is the sole cause. It may be urged that the presence of eggs, or the gnawing of microscopic grubs, seems an insufficient reason to account for the production of an elaborate gall formation.

MAGNIFIED SECTION THROUGH TERMINAL BUD OF OAK.
Showing eggs in lower part laid by wingless female of oak apple gall-fly

But the eggs are invariably laid in contact with what botanists term meristem tissue—that is to say, the particular layer of vigorous cells whose active multiplication by fission brings about the phenomenon which we call "the growth of the plant." These cells are known to possess an extraordinary sensitiveness, and it is not, therefore, unreasonable to suppose that an irritant, however slight, would divert the energy that in normal circumstances would assist in building up the leaf tissue.

Truly a marvellous phase of Nature—that these minute insects should be gifted with the power of diverting to their own uses the cell energy of plants and trees! Moreover, there is further cause for wonder in the fact that each of the many kinds of



SECTION THROUGH AN OAK APPLE (ENLARGED).
Showing chambers wherein the grubs undergo transformation.

gall-flies known to science is bred from a perfectly distinct and characteristic gall. These galls all originate in exactly the same manner ; *i.e.* in the egg-laying of an insect. The reason why they differ so markedly has yet to be discovered. Yet I believe that when this difficult question is cleared up, we shall find that whereas the plant makes the gall in so far as the supply of constructive energy is concerned, the tiny grub (or, in certain cases, the development and swelling of the egg), by irritating the sensitive cells in a peculiar way, determines the form which the gall shall take. In other words, each kind of gall-grub probably gnaws the cells in a manner quite different from that adopted by all other kinds of gall-grubs, just as the caterpillars of butterflies and moths have characteristic methods of feeding upon leaves.

Let us now return to our oak apple. As the spring advances, the little colony of grubs within, each in its separate cell, feeds and grows fat. When full fed, each grub changes to a pupa, and towards the end of June emerges from the gall as a perfect fly. Now these flies differ markedly from their parent — the ant-like insect which laid her eggs in the oak bud. They are inferior to her in size, while each has four wings. Moreover, this generation of the oak apple gall-fly comprises

OAK APPLE IN EARLY SUMMER.

THE WINGLESS FEMALE (FIRST GENERATION).

Which oviposits in the terminal buds of the oak in winter.
(Magnified.)

OFFSPRING OF THE ABOVE.

One of the winged, sexual generation of flies, which comes from the oak apple in summer-time. They lay eggs in the rootlets of oak trees, and their eggs produce agamic, wingless females.
(Magnified.)

the tender rootlets of the oak. As a result, galls are produced upon the rootlets; and in them the winter generation of wingless females comes to maturity. These root galls, by the way, are much smaller and harder than the oak apples. Indeed, they are not unlike little nuts, or stones, and those who wish to find them must search with care. Each root gall, too, has only a few inmates (perhaps only one or two), whereas the oak apple generally contains several scores of grubs.

Let me now briefly summarise the life cycle of the oak apple gall-fly, in order that we may realise how markedly it differs from the life cycles of insects in general. In the first place we saw a tiny insect abroad in the dead of winter, laying her eggs at the heart of an oak bud. As spring advanced, this bud developed into an oak apple gall, which provided food and shelter for a number of grubs. In June these grubs completed their transformation within the gall, and came forth as perfect flies, differing in an extraordinary manner from their parent.

Now, in the case of an ordinary insect, the story would end here. To continue our observations would be merely to verify facts which we had already noted. Not so, however, with the gall-flies. We saw that the egg-laying of the second generation of flies resulted in galls quite different from the oak apple, and that from these galls came wingless female

SECTION THROUGH GALL FROM ROOTLET OF AN OAK (GREATLY ENLARGED).

Showing chambers, one of which contains a grub.

flies, capable of virgin reproduction, such as the one with which we commenced our story. And so this wonderful alternation of generation—this interchange of personality—continues year after year, in apparent defiance of our trite dictum that like invariably produces like. Needless to say, a phenomenon so remarkable has attracted the attention of men of science, and given rise to much discussion and theorising. So far, however, no adequate explanation of the facts seems to be forthcoming.

HAROLD BASTIN.

GALLS ON ROOTLET OF OAK.
Wherein are reared the agamic generation of the oak apple gall-flies.
(About natural size.)

HOW TO KNOW THE WILD FLOWERS

By the REV. H. PUREFOY FITZGERALD, F.L.S.

With Photographs by HENRY IRVING

THE FLOWERS OF THE HEDGEROWS

THE WILD ARUM

THE Cuckoo-pint, or Lords and Ladies (*Arum maculatum*), appears in the hedgerows in April, and, from its curious shape and its dissimilarity to other plants, it is an object that attracts notice readily; it is the only representative of the *Araceæ* that grows in this country.

The leaves are generally to be found in March—shiny, bright green leaves—often marked with black or purple blotches, spear-shaped at the base, and each one with a long stalk coming straight up from the root; the latter will be found to be a white tuber, with a very bitter taste.

The flower stalk is contained inside the curious-looking leafy shelter, called the spathe; if this is carefully pulled away the actual reproductive portions will be exposed—the club-shaped portion at the top is either purple or yellow, making the distinction between the "lord" and "lady." Just below the point where the leafy cowl is folded will be seen a ring of hairs pointing downward, beneath which are the stamens or male flowers, while at the base are the pistils (female flowers), and

WILD ARUM.

DOG'S MERCURY.

WHITE VIOLET.

all these are arranged on and round the curious purple or yellow spike.

The pistils mature before the pollen is set free from the stamens, and each one secretes a drop of honey; attracted by this, flies, and other small insects, creep down easily enough through the fringe of hairs, but these, being arranged

GROUND IVY.

on the principle of the lobster-pot, prevent them crawling out again for the time being. After a while, the pistils begin to wither, and then the stamens mature and shower the pollen over the visitors; the fringe of hairs shrivel up and allow the flies to escape. Since they are well provided with honey, the fact of their being in captivity does not appear to worry them, for when they are liberated they seem quite willing to visit another Cuckoo-pint flower, and if this occurs when the pistils are maturing, they are sure to leave some of the pollen they have brought with them on the sensitive stigmatic surfaces, and in this way effect cross fertilisation. It is an ingenious device, and makes one wonder how many stages these plants have been through, and how many thousands of years it has taken to bring them to this pitch of perfection.

In the autumn, the seed vessels will be seen occupying the place of the pistils—bright red berries, looking like bunches of coral; they are very bitter to the taste and are also very poisonous.

GREATER CELANDINE.

THE VIOLET

This flower needs no introduction for the purpose of identification, but there are a few facts which are worthy of mention. The flowers of both the Sweet Violet (*Viola odorata*) and the Dog Violet (*Viola canina*) are very similar in structure, but the latter, however, is devoid of scent; the green sepals are somewhat different, for in the Sweet Violet they are blunt, while in the other they end in sharp points. Both of these plants (as in the case of the Wood Sorrel) bear two kinds of flowers. Besides the well-known coloured blossoms, a little later in the year there will be found, hidden among the leaves, other smaller, and greenish, flowers with practically no petals. These bear much more seed than the showy ones, and it would seem to be a waste of energy on the part of the plant to produce its coloured blooms at all; probably the reason is that cross fertilisation takes place in these latter blossoms, and thus a cross is occasionally secured. The White Violet, which is frequently found nestling in the banks under hedges, is a variety of the scented kind; the Dog Violet is generally of a paler tint than *V. odorata*. If one of the flowers be pulled to pieces carefully, it will be noticed that the five petals are irregular in shape, and that one of them is lengthened so as to form a covering for the spurs of two out of the five stamens; it is inside these two spurs that the honey is secreted. The free ends of the stamens have small membranous expansions which overlap and form a ring round the pistil;

WHITE DEAD-NETTLE.

this arrangement provides a hollow space into which the pollen falls. When a bee visits the flower, its head comes in contact with the pistil, and moves it, so that the pollen falls down on to the bee's head, and on its visit to the next flower is brought on to the stigma.

The Violet pollen is much drier than that of most flowers, so that it readily falls from the anthers into the hollow space referred to.

DOG'S MERCURY

The Dog's Mercury (*Mercurialis perennis*) is to be found abundantly everywhere. It flowers in the early spring, and the blossoms appear before the leaves are fully expanded. It is not a herb that attracts very much attention or admiration; the whole plant, flowers and all, is green, and grows about a foot high. The male and female blooms are borne on different plants, thus entirely preventing self-fertilisation, and the male flowers are arranged in little clusters, but the females singly or, at the most, two together. One of the most interesting points to be noticed is the manner in which the leaf bud is protected; the young stems are bent over so that they can readily push their way through dead leaves, moss, and other such obstacles, and each leaf is rolled inwards in such a way that the rough midrib is uppermost and protects the delicate green tissue.

The name Mercury is derived from the god of that name and refers to the poisonous properties of the plant, whilst the prefix "Dog's" is a term applied to worthlessness.

THE GREATER CELANDINE

The Greater Celandine (*Chelidonium majus*) has already been mentioned (p. 17) as being quite distinct from the Lesser Celandine (*Ranunculus ficaria*), and if the two plants are put side by side it will be readily seen that they are very dissimilar except in name. The Greater Celandine begins to flower about May and continues, more or less, throughout the summer; the fact that it has two sepals and four petals proclaim it to be one of the Poppy family. The stem grows sometimes as much as two feet in height, and secretes a very acrid, poisonous, yellow juice, which, at one time, was used for various medical purposes; the leaves are light green on the upper surface, and bluish green beneath. The photograph shows clearly how the leaves are divided up into segments. The flowers are small and bright yellow, and from three to six of them are arranged on short stalks, which all spring from the same point.

The name Celandine comes from the Greek *Chelidon*, a swallow, and it may be that both the plants of this name were so called because they come into flower about the same time that the swallows appear. But Pliny and Aristotle have a different story; they relate that the juices of the plant were used by the swallows to restore sight to the young ones when their eyes had been put out.

GROUND IVY

The little herb that is commonly called Ground Ivy (*Nepeta glechoma*) is no relation of (and indeed bears no resemblance to) the common Ivy, and why it should have been so named it is hard to imagine. It is one of the somewhat large family of *Labiatæ*, or lipped plants, so called from the irregular shape of the flower, and well represented by the Dead-Nettles. The petals are united to form a tube, and the outer extremity of this is divided so as to make two lips. The plant trails along the ground, sending out root fibres at intervals, and upright flowering stems from six to eight inches high; the leaves are circular with kidney-shaped divisions at the base, the lower leaves being larger and on longer stalks than the upper ones. The purple flowers are borne in semicircular clusters round the stem, and the plant, when bruised, gives out an aromatic smell. Most of the flowers will be found to bear both stamens and pistils, but on looking over the plants carefully, smaller flowers will frequently be found bearing pistils only; in the case of the former the stamens shed their pollen and wither away before the pistils waken, in order to prevent self-fertilisation. The Ground Ivy, at one time, was used for making beer, whence come the old local names, "Ale-hoof," "Tun-hoof," and "Gill-go-by-ground"; a decoction of it was also used as a cure for consumption. It blooms from March well on into the summer, and is abundant in nearly all hedgerows and waste places.

WHITE DEAD-NETTLE

The White Dead-Nettle (*Lamium album*) is a well-known plant, the leaves of which resemble those of the Stinging Nettle, and probably gain some immunity in so doing, for protective resemblance is not confined to the animal world. The shape of the flower will at once show it to be one of the *Labiatæ*. There is a supply of honey secreted at the base of the tube, which is well protected from the wet by the arching upper lip, and also from the ravages of small, undesirable insects by a fringe of hairs; the flower is adapted especially for humble bees, whose proboscis is long enough to reach the honey. Examine a flower carefully and notice the

YELLOW NETTLE.

GARLIC MUSTARD.

two pairs of stamens, one short and one long, and the stigma hanging down below them. When a bee alights on the lip, it comes in contact with the stigma before it touches the anthers, so that any pollen it has brought along from another flower is rubbed off before it takes a fresh supply. The leaves are arranged in pairs, and the flowers in a circle round the stem, there being from six to twelve of these in a cluster. When the plant is bruised, a rather disagreeable odour is given off.

THE YELLOW DEAD-NETTLE

The Yellow Dead-Nettle (*Galeobdolon luteum*) is not so common as the white one, but in general appearance and shape the two resemble one another very closely; but the flowers of this plant are bright yellow, and the lip is spotted with a darker colour; it is to be found in flower from April to June. The common name of "Weasel-snout" is given to it on account of a fancied resemblance of part of the flower to the nose of a weasel. The Red Dead-Nettle (*Lamium purpureum*) is also found very commonly in the hedgerows and as a garden weed. All these Dead-Nettles bear the name of "Archangel," but why

WOOD SAGE.

they were so called it is hard to say, unless it was because they were all to be found in flower about May 8th, the Archangel St. Michael's day.

WOOD SAGE

Another representative of the *Labiatæ* is the Wood Sage, or Wood Germander (*Teucrium Scorodonia*), which is found abundantly, and flowers throughout most of the summer and autumn.

The pale yellow flowers are in pairs, with a tiny leaf (bract) at the base of each little flower stalk; the calyx has one broad and four narrow teeth. The stamens ripen first, and then curl backwards out of the way, allowing the pistil to move forward, so as to come in contact with any visiting insect which is bringing pollen from a less mature flower.

GARLIC MUSTARD

A tall growing plant with shiny leaves and small, white flowers, blooming in the spring, will probably be the Garlic Mustard, or "Jack-in-the-hedge" (*Alliaria officinalis*). Examine one of the flowers and notice the four separate petals arranged in the form of a cross, the four sepals, and the six stamens, two of which are shorter than the others; these points are common to all the family of *Cruciferæ*. The lower leaves have longer stalks than those higher up the stem, and the latter are more definitely triangular in shape and more regularly toothed. The plant may very easily be recognised by its strong scent of garlic when any portion of it is bruised, which accounts for the two common names, Garlic Mustard or Hedge Garlic.

H. PUREFOY FITZGERALD.

HOW TO KNOW THE BIRDS

By the REV. MAURICE C. H. BIRD, M.A., M.B.O.U.

THE SWIMMERS—II

THE ducks may be divided into surface feeders and divers, although all ducks are, at a push, expert divers. As is the case with the Mallard, all the commoner species differ very much in sexual plumage, with the exception of the Black Duck, or Scoter. Although the distinctive differences of adult males in the various species are easily discernible, the female of one kind may approximate very closely to the female of another species. Such is the case with the female Wild Duck and the female Pintail, but the latter is of a lighter brown body colour and slightly smaller. The neck is longer in proportion and more slender, and the two centre tail feathers are slightly elongated. The speculum, or wing spot, is dark green shot with copper, and not purple shot with green, as in the Wild Duck and Mallard. There can be no possible difficulty in differentiating between the drakes of the two species. The Mallard's blue-green

Photograph by J. Atkinson, Leeds.
PINTAIL.

head, white neck-ring, beautifully vermiculated flanks, curly black feathers above the tail, and orange feet and legs, are unmistakable, and are too well known to be confounded with the brown head and wide white neck stripe of the long-tailed male Pintail. The latter is a comparatively rare bird, but is not to be confounded with the rarer true Longtail, which is a sea-duck, and much smaller. The female Shoveller, too, does not differ much at first sight from the Wild Duck, except in its smaller size and the spatulate extension of the beak. The sides of the beak, too, are furnished with much more highly developed fringes of slender *lamellæ;* those on the upper mandible fit into those situated on the lower part of the beak, and thus make an excellent strainer for sifting out minute forms of animal life from the surface of the water in which the Shoveller delights to bibble. Whilst on the wing, the adult male shows much white on the shoulders and under parts.

The female Wigeon, though smaller still than the Shoveller, is somewhat like the Wild Duck, but the back is nearly a whole-coloured brown, and the breast and belly nearly white. In shape and colour the female Teal, the smallest of all our ducks, approximates more nearly to the female of the Mallard.

Photograph by J. T. Newman, Berkhampstead.

MALLARD ON NEST.

The Shoveller is not at all a loquacious bird, but the "tharp" of the Mallard, "quack" of Wild Duck, "crick" of Teal, and "wheoh" of Wigeon, are well-known sounds to all flight-shooters, whilst the most proficient of marsh gunners will identify all the commoner species of duck in the dark by their various wing sounds, and even by the specific splash which they make on rising from the water. Generally speaking, all ducks feed chiefly at night, and rest by day, except, of course, when frost compels a change of custom.

The male Wigeon carries a cream-coloured crest. In fact, in full plumage

Photograph by J. Atkinson, Leeds.

POCHARD.

the whole head is creamy chestnut, the throat is black and chocolate below, and the upper surface of the body delicately vermiculated with grey and black. The male Teal is also similarly coloured above, but the head and neck of deep chestnut with broad green stripe outlined with white, extending from around the eye down the sides of the neck, is a distinctive characteristic of the most beautiful and tamest of British wildfowl.

Wild Duck, probably on account of the increased artificial rearing of these birds for sporting purposes, are on the increase, and for some unaccountable reason Shovellers also have of recent years bred more frequently in several counties; but, on the other hand, for an equally inexplicable reason Teal do not so often stay to rear their young here as was the case five-and-twenty years ago.

Coming to the diving ducks, the Pochard or Dunbird — so-called from the colour of the head, which is dark dull brown in the female and chestnut-red in the male—is the most common. It occurs in large flocks during the winter months—resting by day at sea generally, and coming to feed on inland waters at night. But on the Broads, reservoirs, and large undisturbed pieces of shallow and weedy water, where food is plentiful, Pochards frequently spend both night and day. In favourable localities a few pairs remain to breed. The speculum, or wing patch, in this duck is grey and indistinct, and the beak black with a lead-coloured band across the middle. The crimson iris of the adult male is also a distinguishing but an unreliable feature, as it is not assumed until about the end of the year, and frequently fades to yellow after death. I have, in fact, watched the process in a wounded bird.

Of the three black and white ducks the Tufted, or Black-headed Poker, is the most common, and seems to be on

Photograph by J. Atkinson, Leeds

SHOVELLERS: DUCK AND DRAKE.

Photograph by J. Atkinson, Leeds.

WIGEON.

the increase as a breeding species. In both sexes the head tuft is unmistakable: in old males the elongated feathers extend an inch or two beyond the nape; in the females they are not so apparent, and the black is not nearly so intense. In both sexes of the Golden Eye the feathers on the nape and upper neck are thick and narrowed at the back, but there is no real tuft or plume. The beak and feet of the Tufted Duck are slate colour, the under parts and wing patch white. The male Golden Eye in full plumage has a large white spot on the face, and the female Tufted Duck has sometimes a small and indistinct patch of white between the eye and the beak; but the female Scaup always possesses a broad white band at the base of the beak. The young male Scaup shows this less distinctly; the adult males have the head, neck, and upper part of the breast a lovely glossy green black; the beak is broad—about as long as the head and slightly tilted upwards—and in colour dull grey with a black nail. The feet and legs are lead colour, whilst in the Golden Eye they are yellow, mottled with black in the young. Both are winter visitors, and their presence often presages hard weather.

I have heard it said by those who knew him well that the late Mr. E. T. Booth, of Brighton Museum fame, could identify most of our birds by handling them behind his back; and in the case of the Golden Eye—the most expert of our diving ducks—the largely developed hind toe would be the first thing to be felt for. It is marvellous to watch these restless birds constantly diving for food in a "wake" (the local name for an open space in the midst of an otherwise frozen sheet of water); they never seem to make a mistake by coming up under the adjacent ice, however small the diameter of the "wake" may

Photograph by Wm. Farren, Cambridge.

TUFTED DUCK.

be. In flight their rapidly vibrating pinions make a peculiar noise which has won for them the alternate name of Rattlewings.

All the diving ducks have the legs placed far back, their generally smaller bodies are rounder and more thickly clad with down, their wings are comparatively shorter and more curved, and their flight is more hurried and irregular than that of the surface feeders. They never wheel about in the air with graceful ease, or for mere enjoyment—as, for example, Teal apparently do; and when alighting on the water they cut the surface with a long, sliding splash, whereas the surface feeders, with outstretched wings and feet, face the wind and gently sit afloat as soon as the body touches the water line.

The moulting season is a trying time for ducks. The Mallard, for instance, sheds nearly all his pinion feathers simultaneously, and is consequently incapable of flight for some few weeks together, and thereby exposed to many dangers. Nature, however, steps in to render him less conspicuous than he would be were his gaudy courting dress retained. Instead thereof he is meantime clothed in what is aptly termed an "eclipse plumage," wherein he closely simulates his spouse's feathering, and thus soberly attired is better fitted to escape the observation of his foes.

MAURICE C. H. BIRD.

HOW TO KNOW THE TREES GROWING IN BRITAIN

With Notes, descriptive and photographic, for their Identification in all Seasons of the Year

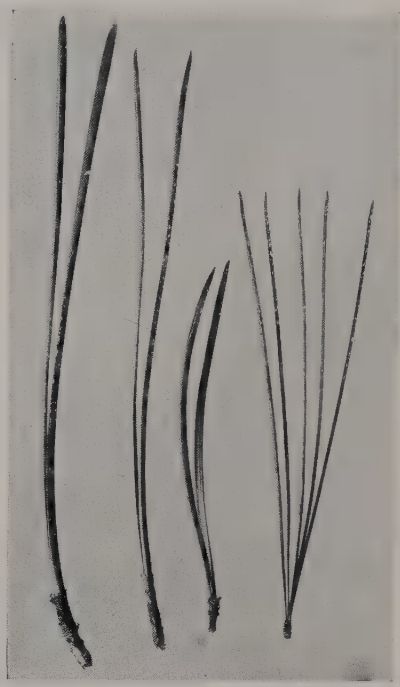
By HENRY IRVING

THE CONIFERS—FIRS AND PINES

THE trees included under the general title Conifers form a very large and important class. Their character is so distinctive that they stand apart from all others.

Nearly all of them are evergreen, their leaves remaining attached for a series of years. A notable exception is the Larch. The nature of these long-persisting leaves has undergone special modification with a view to their endurance through extreme variations of temperature and climate. As a consequence of this modification these trees can live and thrive in exposed situations, braving the winds, unharmed by the snow, where other trees would suffer rending and maiming. In texture these leaves are hard and leathery; in shape they are long and very narrow, exposing but the smallest surface, reducing transpiration to a minimum, offering least resistance to the wind. The little surface that is exposed is smooth and shiny, and from it the snow slips off before its accumulation becomes a peril.

Their flowers are crowded together, in the shape of spikes or cones, which again may be grouped into clusters; but each cluster comprises one kind of flower only, which is either pollen-bearing or fruit-producing. These are generally found on the same tree. The quantity of pollen thrown off is enormous, floating away in clouds, settling and forming drifts in places, giving rise to the frequent country legend of a sulphur shower. Conifers rely upon the wind alone for the conveyance of the pollen, and the abundance of this is a precaution against failure.



NEEDLES OF CLUSTER, AUSTRIAN, SCOTS, AND WEYMOUTH PINES.
(From left to right.)

Under the microscope each pollen grain is seen to possess two air bladders in aid of flight.

Their fruits are, with exceptions, the familiar woody cones. These are made up of hard scales spirally arranged round a central axis. These scales overlap like tiles, being further made secure by a resinous glue. Enclosed and protected by these the seeds mature, two in each scale-roofed chamber, till such time as they are fully ripe. Eventually the scales relax, in some instances gaping open, in others separating and falling, to set free the seeds, which, being winged, are wind borne and dispersed. But some Conifers, as the Yew and the Juniper, produce not cones but stone-fruits, having their seeds surrounded by or embedded in an edible pulp.

All the Conifers which will come under notice here, with the single exception of the Yew, belong to the Pine family. This includes the Firs, with leaves single but crowded on the twigs; the Pines proper, with leaves in bundles of two, three, or five; the Larch and the Cedars, with leaves in tufts of twenty or more; the Cypresses, with leaves as close fitting scales.

THE FIRS

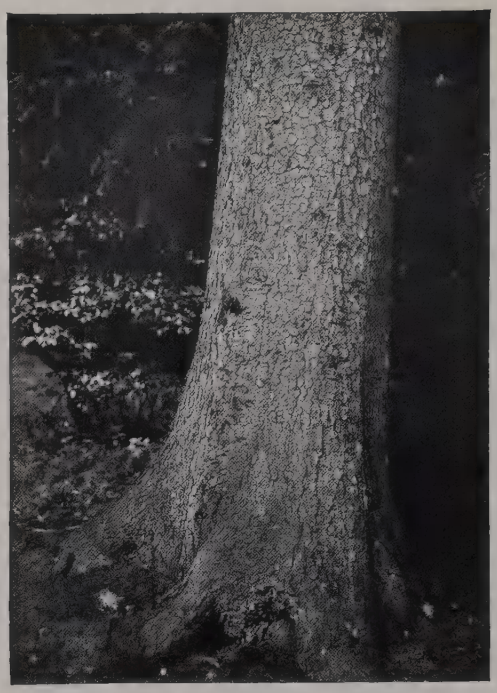
Those most commonly found are the Spruce, the Silver Fir, and the Douglas Fir. The shape of a Fir tree is pyramidal, having its branches arranged circularly and outspreading, at regular intervals up the main stem, longest below, shortening gradually upwards to the leading shoot, which makes the apex of the pyramid. Each unbranched interval on the main stem represents a year's growth.

In distinguishing between the Firs, and for comparison with the Pines, chief attention may be given to the leaves and the fruits. The leaves of the Firs, attached singly, and having the appearance

SHOOTS OF CONIFERS.
Spruce. Douglas Fir. Larch.
Scots Pine. Austrian Pine.

SPRUCE.

DOUGLAS FIR.



TRUNK AND BARK OF SPRUCE.

of short lengths of ribbon, are arranged in a close spiral, crowded together, but, as it were, combed out flat on either side of the twig, the object being to get the breathing surfaces underneath. The fruit cones of the Firs have scales of a uniform thickness, whilst those of the Pines show scales having either a central or terminal swelling.

The Spruce. The bark is reddish grey, and flakes off in thin rounded scales. The leaves are short, narrow and thick, nearly square in section. They appear as if stroked down on to the twig, rather than combed out laterally, and are of a dark uniform green. The glistening brown cones are spindle-shaped, and hang with their points downwards. They remain on the tree through the winter. Some time in the following summer the cone-scales gape apart, setting free the ripe winged seeds. Later the empty cones fall bodily.

The Silver Fir. The tree becomes less distinctly pyramidal, its top grows bushy and eventually flattened. The bark is a lighter grey, its scales are less rounded, and there is the suggestion of fissures. The leaves are longer, broader, and relatively thinner. Their under surface is marked along its whole length by a pair of shining silver lines. The leaves are more distinctly combed out. On the fruiting branches, which are always near the summit of the tree, they curve upwards, exposing freely their silvery undersides. The cones are cylindrical and stand erect. Their surface is roughened by spiny projections emerging from under the scales. When the fruit is ripe, in the autumn of the same year, the cone-scales loosen and fall, releasing the seeds. Only a bare central spike remains on the tree.

The Douglas Fir. The bark is thick, reddish brown in colour, and deeply furrowed. The leaves are more delicate in texture. On the horizontal twigs they are so flattened out on either side that they might have been subjected to pressure. They show two thin silvery lines on the under side. The cones are egg-shaped, of a light brown colour, and they hang downwards. Lying upon and projecting over each woody scale is a soft fibrous scale in the form of a trident, an

TRUNK AND BARK OF THE SCOTS PINE.

AUSTRIAN AND CLUSTER PINE BUDS.

ornamentation that gives to these cones a distinctive appearance. The fruit is ripe in late autumn, when the scales gape open, setting free the seeds. The empty cones fall later.

THE PINES

The shape of a Pine early in life is pyramidal, but later this symmetry is generally broken. The leaves are long and narrow, aptly characterised as needles. They are not solitary, but grow in bundles of two, three, or five, which are confined at the base in a sheath. A Pine cone, after forming, ceases to grow throughout the first year. It starts into growth the following spring, generally maturing by the next autumn. The small lump, or boss, is always present on the exposed part of each cone-scale. The cones are pendent, and they release their seeds by opening their scales.

The Scots Pine. This is our one native Pine. The mature habit of this tree is to cast off its lower branches, sustaining, on tall stem, a rounded or flattened crown. The bark near the base thickens, exhibiting a series of dark, flattened plates, separated by fissures; but higher up, where the thin scales peel off, the general surface is of a bright coppery colour. The needles, two in a bundle, united at the base in a brown sheath, are bluish green. Their length is about two inches. The cones, which are about two inches long, and taper quickly, grow sometimes three together, but generally in pairs, side by side, with their central axes parallel. The exposed part of the cone-scale is four-sided, and is raised to a point in the centre. Its surface is not polished.

The Corsican Pine, and its Austrian variety, may best be distinguished from the Scots Pine by the following: The bark is fissured and uniformly thick and dark, from the base to the summit. The bud is cone-shaped, with a long-drawn-out point, silvery, and thickly covered with resin. The needles, two in a bundle, and sheathed at the base, are rather longer and of a darker green. The cones also are larger, and as they grow in pairs their attitude is different. They are attached base to base, with their central axes in a line, or nearly so. They have a polished surface.

The Cluster Pine. The bark is dark, coarse, and deeply furrowed. The buds,

CONES OF CONIFERS.

1, Spruce. 2, Larch. 3, Weymouth Pine. 4, Douglas Fir. 5 and 6, Scots Pine first year and full grown. 7, Cedar. 8 and 9, Austrian Pine first year and full grown.

about an inch long, are torpedo-shaped. These are not coated with resin, but the ends of the scales curl outwards. The needles, two in a bundle, and sheathed at the base, are six or eight inches long, and as to give the cone a spiked appearance. The cones often remain on the tree for years.

The Stone Pine. From its spreading manner of growth this is often spoken of

SCOTS PINES.

thick in proportion. They are clustered together on the branches and form handsome tufts. The cones grow several together, radiating round the branch. Each cone is about six inches long and unevenly developed, bulging on the exposed side, and curving towards the point. It has a shiny surface. The central swelling on each scale is so pronounced as the Umbrella Pine. The bark is reddish grey, thick and deeply furrowed. The buds are conical and have curled scales. The needles, two in a bundle and sheathed at the base, are similar to those of the Cluster Pine. The cones are not clustered, they are nearly globular, their scales are not spiked, but show a raised flat surface with a central depression.

They require three years to reach maturity. Their contained seeds are large, suggestive of a fruit-stone, hence the name Stone Pine. Each seed has a tiny wing wholly inadequate for any purpose of flight. This Pine has, in its later evolution, come to rely upon animal agency for the dispersal of its seeds.

The Weymouth Pine. The needles here are five in a bundle, sheathed at the base only when first expanded. They are long, very thin, and soft in texture. These are also crowded together, forming considerable tufts, spreading in summer, but closing together in winter. The cone is long and thin, spindle-shaped, and curved. Its most distinctive peculiarity lies in the fact that the swelling on the cone-scale is not central but at the tip.

The Himalayan Pine is scarcely distinguishable from the Weymouth except that its needles are longer and its cones larger every way.

Note.—Other imported Pines are "too numerous to mention," but those briefly distinguished above are most frequently met with.

HENRY IRVING.

THE RUSHES

By MAUD U. CLARKE

With Photographs by HENRY IRVING

THE true Rushes are a small family that, nevertheless, spread themselves in ample fashion over the world.

The general impression of the Rush, as recognised in such common varieties as the Soft Rush, Hard Rush, etc., with cylindric leaves and inconspicuous flowers, would hardly lead us to suppose that the plant was a near relative of the Lily family. Yet such is the case, for in the classification of the Order *Hypogynæ* (plants having the perianth, or corolla and calyx collectively—inferior, or absent altogether), the *Liliaceæ* and *Juncaceæ* have many points in common.

The two Orders are placed consecutively: in both, the sepals, petals and carpels number three in each instance, the stamens six—as a duplication of the idea of three—the seed-capsule is three-chambered, and the seeds either three or many.

To ordinary observation a great difference exists between the conspicuous flowers of the Lily family, and the inconspicuous brown ones of the Rushes; yet the magnifying glass dispels the illusion to a very considerable extent.

Of the Lily family, I would instance the Bog Asphodel (*Narthecium ossifragum*), with its tufts of grass-like leaves and yellow star of six petals, and the Flowering Rush (*Butomus umbellatus*)—a single specialisation from the *Alismaceæ* or Water Plantain family—as showing distinct relationship to the Rushes. The latter plant has six rose-coloured perianth leaves, the three outermost tingeing towards brown and approaching the colour-idea of the perianth leaves of the Rushes. The long leaves of the *Butomus* are in character sharply keeled and sheathed on the stems like the Sedges, yet the flowering construction is that of the Rushes.

A magnified flower of *Juncus compressus*, with the six oval perianth leaves expanded showing the six stamens lying within them surrounding the seed-capsule, has a close resemblance to that of the Flowering Rush, although the latter plant possesses nine stamens and six carpels. The tribe *Juncaceæ* are definitely distinguished by the cylindric leaf of polished surface filled with pith; they are sometimes grooved, but rarely flat

like grass. The flowers are either distinct, or grouped in irregular panicles, the seed-capsule being three-celled and containing many seeds. The plant is always associated with more or less marshy or boggy ground.

If we pull a specimen of *Juncus communis* carefully from the ground we find the green leaf emerging from two chestnut-brown sheaths that partially wrap round the base; the inner one extending five or six inches upwards upon it, the outer, and darker one, for about half the length. These sheaths are of stout texture, admirably waterproof, toughening where they approach the root, and thinner in the upper extremity where they only partly enfold the leaf. The rootstock is a running one, with fibres extending from it; from the root the young leaf-shoots emerge above the surface of the ground, very sharply pointed, and varying in colour from whitish to a bright chestnut. The species has two extreme forms, that of *Juncus glomeratus*, or Dense-flowered Rush, and *Juncus effusus*, the Loose-flowered variety. There seem to be very many gradations between the two—often found in close proximity to each other.

FLOWERING RUSH.

JUNCUS COMMUNIS.

ROUND-FRUITED RUSH.

In autumn the partially dry stage of the Rushes gives a beautiful mass of orange colour to the landscape, the tips of the leaves and stems being so tinged before they fade later into the varied grey and drab tones so appreciated by the painter.

The Hard Rush (*Juncus glaucus*) differs mainly in the more rigid and slighter form of stem, which is finely grooved and of a grey-green colour, and the looser panicle

HARD RUSH.

of flowers held almost vertically. The capsule is longer than that of the Soft Rush, and terminates in a point. It frequents roadsides and many moist places, growing together with the Soft Rush on boggy commons or round the margins of ponds. *J. effusus*, very like the Hard Rush, is said to be a hybrid between both varieties. I met with it recently, and found the stem rigid some little distance from the base, the grooves quite distinct; but in the upper length it became softer, slightly flattened and twisted. The panicle was of the loose vertical order, the ripened capsules broadly oval, but showing the distinguishing point of *J. glaucus*.

In *Juncus compressus*, or Round-fruited Rush, the stem is also slightly compressed at the base. It is a very slender, erect Rush, not more than one foot to one and a half feet high, and making a departure from the type in having a few nearly radical leaves, and one or two higher on the stem of the channelled order and narrow in form. The panicle is a loose terminal one of shining brown colour, the flowers arranged singly, or rarely clustered. The small perianth segments are rounded, as referred to previously in connection with the Flowering Rush. It lives in wet, marshy places, especially near the coast, but is not so generally spread over Britain as the other Rushes, and not often inland. The flowering lasts all through the summer.

GREAT WOOD RUSH.

Another Rush that stands apart from the type-form, with cylindric leaves, is the Heath

HEATH RUSH.

Rush (*Juncus squarrosus*). Adapted to drier regions than others of the family, its characteristics incline towards those of the Grasses. The leaves are all radical, save for a bract leaf on the flowering stems in some instances, and spread in tufts laterally; they are of narrow grooved shape, stiff in character, and not more than half the length of the stems. The flowers are contained in a terminal panicle that is little branched. The perianth segments are of a glossy brown colour and broad in form, as seen in the illustration, enclosing the seeded fruit of the two principal stems. At the top spikelet of the taller stem we see the style of the carpels still adhering, the extremity being a three-forked arrangement of slender threads. The species is quite abundant over Britain on moors and heaths; the rigid stems are under one foot in height.

BLACK BOG RUSH.

A departure from type-form is even more marked in the Great Wood Rush (*Luzula sylvatica*), for here the generic name has been shifted to meet the requirements of the plant's specialisation. There is much difference in the soft flat leaves that approach those of the Grasses, and are covered thinly with white hairs. Another distinctive character is the one-celled capsule, which contains but three seeds, larger than most of the species. It prefers dry situations—woods or pastures that are well drained or stand at an elevation; the height varies from one and a half to two feet, the leaves being rather less. The flowers are expressed in little clusters of two or three in a large, loose panicle.

One of the Rushes associated with the damp regions that has some superficial resemblance to this form of panicle is the Jointed Rush (*Juncus lamprocarpus*). A slender compressed stem bears the panicle, that is leafy to some extent. The peculiar formation of the radical leaves gives the name to this species; they are first sheath-like upon the stem, but afterwards cylindrical and hollow, divided interiorly by cross segments of pith, which mark such divisions clearly in the dry state, and give the appearance of articulated joints. The flowers are in small clusters—from three or four to as many as ten—arranged in compound terminal panicles. The perianth segments are about the size of the Common Rush; the capsule more or less pointed. It is an exceedingly variable species in habit and size, but always to be distinguished by the jointed leaves. I have found it on damp commons in both its extreme measurements, viz. in rich soil, from two to three feet, with panicles five or six inches diameter; and also in its diminutive form of a few inches only, when the panicles are less complex and of a much darker brown colour. It will also spread over water, rooting at the joints, which appear to be centres for possibilities of varying requirement.

I have used some latitude in placing the Black Bog Rush (*Schœnus nigricans*) with this selection of plants, since it is not a Rush from a botanical standpoint, but a Sedge. It is, however, so rush-like in general appearance, more nearly approaching type-form even than the Wood Rush, that it appeared to me the more interesting to show the plant as a rush-like Sedge among Rushes, than in its own class. But let it not be forgotten that the fruit is the single nut-like seed that separates the plant at once from the Rush family. The small rounded spike of glumes is variably a dark reddish brown or black-brown, composed of three or four

to ten spikelets grouped closely together, and surrounded with broad, brown, leafy bracts stiffened at the tip into points extending in some cases considerably beyond the spike. The spikelets are without stalks, and contain one to four perfect flowers, the other glumes being empty; the perianth of the tribe *Schœnus*, or Bog Rush, has either the construction reduced to a few bristles or it is absent altogether. There is a noticeable character in the way the sedge-like sheathing base of the leaf abruptly alters into the more rush-like contracted form, with a tendency to flatten and twist upon itself. In all these bog plants there is careful supply of the waterproofing construction at the base, where special membranous bract-forms meet the emergency of habitual contact with water.

MAUD U. CLARKE.

Photograph by T. Meyer, Streatham, S.W

POND LIFE—III

By F. MARTIN DUNCAN, F.R.P.S.

With Photographs by the Author

IF we pay a visit to a pond covered with Duckweed, and carefully collect some so as not to injure the slender, submerged stems and roots, and on our return home place our treasure in a glass tank filled with water, we shall probably be rewarded by finding that we have also obtained some specimens of one of the most interesting inhabitants of the pond. On looking carefully at the miniature forest of Duckweed stems, as they hang downwards in the tank, we shall see that some of the stems have attached to them what looks like a tiny greenish lump. After watching the lump for a few minutes, we shall see it begin to elongate, and a circle of slender arms or tentacles will appear round the top, something like a little crown of waving snakes. This quaint little animal—for an animal it is, and not an excrescent growth on the side of the stem—is called the Fresh-water Hydra, and has gained its popular name from the crown of waving arms.

The Fresh-water Hydra is a relation of those exquisite Garland Polypes, the Compound Hydrozoa, which inhabit the rock pools on the seashore. Its life-history is not quite so remarkable as that of its marine relations, as it never becomes a true colony, nor does it produce tiny Jelly-fish babies, but, nevertheless, it is a very interesting and curious little creature. For instance, it does not remain attached to one spot throughout its life, but is very fond of shifting its quarters from one place to another; and to watch it travelling down the submerged stem of a water-weed, or along the glass sides of the tank, is to witness a very remarkable gymnastic performance. When the Hydra wishes to change its quarters, the tiny creature elongates its body and arms, and bending over sideways until its body

forms a loop, brings its head and arms in contact with whatever it may be resting on. The Hydra, grasping this support with its arms, now relaxes the hold which attached the base of the body, and slowly turns a complete somersault. In this way, alternately using its arms and "foot," the little creature moves along by a series of stately somersaults until its destination is reached.

With the aid of a good hand magnifying glass, we can make out more clearly some of the characteristics of the Hydra. In the centre of the waving circlet of arms is an opening, which is the mouth of the creature, and which leads straight down to the digestive chamber. Close inspection of the arms, or tentacles, will reveal the fact that they are more or less thickly covered with very complex cells, the stinging cells, or *nematocysts*, by means of which the Hydra wounds and captures its prey. These stinging cells are similar to those found on the tentacles of the Sea Anemone, which I have already described on page 380.

FRESH-WATER HYDRA.

If a healthy and well-nourished Hydra is kept under observation in a small glass jar, a little nodule will be seen to make its appearance on the side of the animal's body, and to grow outwards and develop a crown of tentacles which wave about and capture any minute organisms that come within their reach. This baby Hydra grows, and after a time, becoming detached from the parent, settles down on its own account. Sometimes the Hydra develops a waist, which becomes smaller and smaller until the top half breaks off. This upper, tentacle-crowned portion then develops a base, while the fixed lower portion grows a crown of tentacles. In the autumn the Hydra produces eggs, from which escape the young, which gradually develop their tentacles.

At certain seasons of the year, a glass of water drawn from a pond will be found to contain a large number of more or less oval-bodied creatures, which move about very rapidly in the water with a curious jerky motion. From their quaint mode of progression, these little creatures have gained their popular name of Water Flea, although really they are not insects at all, but distant relations of the shrimp and lobster, belonging to that group of animals which are included in the Crustacea. Occasionally they appear in such vast quantities as to give the water quite a milky appearance, and finding their way into the domestic water pipes, cause considerable trouble.

The movements and general appearance of the Water Flea, or *Daphnia*, to give it its scientific name, are very interesting to watch with the aid of a good hand magnifying glass, or, better still, under the microscope. It will then be seen that the little animal is enclosed in a transparent, oval or nearly circular shell, terminating at the base in a sharp serrated spine. So transparent is the shelly casing of the body, that most of the internal anatomy of the Water Flea can be easily distinguished, and under the microscope, with a moderate magnification, the heart may be seen beating. The eye of the Water Flea is a very bright and handsome organ, and looks like a tiny jewel.

The Water Flea belongs to the division of the Crustacea called the *Entomostraca*, and this division includes, as well as the Water Flea, other small and interesting inhabitants of the pond, called respectively the Cypris and the Cyclops. The little Cypris differs considerably in size and appearance from the Water Flea; the shell is not quite so oval, but rather more like the seed of a haricot bean, or a kidney, in shape; and is generally fringed or covered

with short hairs. The three forms most frequently met with are the Green, the White, and the Brown Cypris; all to be found swimming in ponds.

THE WATER FLEA.

The most familiar Cyclops, and one that is to be found in most ponds, is the Four-horned Cyclops (*Cyclops quadricornis*), which has an oval head and tapering body terminating in two groups of stout bristles. This Cyclops has gained its popular name from the four horns or antennæ which adorn its head. The female is easily distinguished, as she carries two pear-shaped egg-sacs or ovaries, one on each side of her tapering body. Besides the common Four-horned Cyclops, Lord Avebury has described six or seven short-horned species as being fairly common in the Kentish ponds.

It is well for the Water Fleas that they are such a remarkably prolific tribe, for otherwise they would soon become extinct, so numerous and voracious are their foes. Nor are the enemies of the Water Flea confined to the animal kingdom, for there is one remarkable pond plant which must account for a comparatively large number in the course of the year. This is a plant called the Bladderwort (*Utricularia vulgaris*), frequently to be found growing in ponds and sluggish streams. It is a curiously interesting plant, living and floating at the surface of the pond during the spring and summer, but sinking to the bottom at the approach of winter. Its straggling stem bears numerous, much-divided slender leaves, and for a few weeks in the summer it sends up a flower-stalk bearing quaint orchid-like golden blossoms. But the most remarkable feature of the plant consists of the numerous little oval bodies attached to the submerged stem, which look like tiny bladders or floats, and from which the plant has gained its name of Bladderwort. At one time it was generally supposed that these processes acted as bladders to buoy up the plant and keep it afloat near the surface of the water. Modern scientific research has proved, however, that this is not the case, but that these bladders play a very important part in providing certain forms of food necessary for the growth of the plant. Indeed, we now know that the Bladderwort belongs to that curious and intensely interesting group—the carnivorous plants. All these plants grow in more or less marshy situations, where the supply of nitrogen in the soil—so necessary to their growth—is low; as a consequence of this environment, they have, in the course of ages, gradually evolved special organs for obtaining the required supply of nitrogenous material by other means than from the soil.

In the case of the Bladderwort, the

THE FEMALE CYCLOPS.

supply of nitrogenous material, required by the plant for the building up of its tissues, is obtained through the agency of the bladder-like processes. When we come to examine these "bladders" closely, we find that they are really very complex organs. Each is a hollow chamber, the entrance to which is closed by a semi-

transparent membrane or door; this can be pushed inwards by any small creature desiring to enter, but it closes again, and cannot be opened from the inner side. Whether the Water Fleas, like most creatures, are imbued with the sense of curiosity or not, it is difficult to say, but that they are attracted to the bladders is very evident. They swim about with their curious jerky motion amongst the bladders, and finally push open the alluring trap-door, and discover too late that they are within a prison from which

ONE OF THE "BLADDERS" IN WHICH THE BLADDERWORT ENTRAPS WATER FLEAS.

escape is impossible. Within these curious bladder-like prisons the Water Fleas soon die, their bodies are decomposed by bacteria, and the products of decomposition are absorbed by the plant and stored within its tissues to be utilised in the process of nourishment and growth.

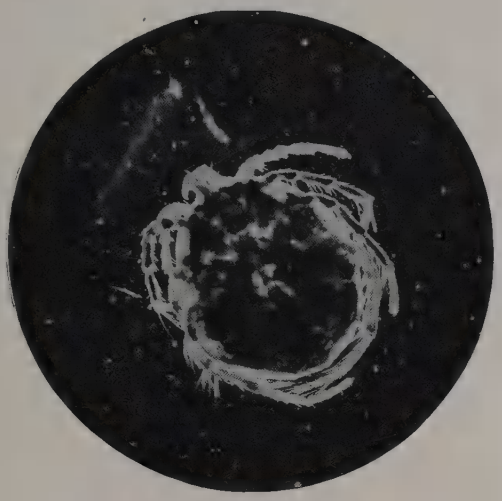
The beautiful little Water Mites, cousins of the Water Spider, abound in the ponds throughout the summer months. Some idea of how numerous these Water Mites are, may be gathered from the fact that Mr. Saville Kent has detected about forty British species. Perhaps the most conspicuous is the Round Red Water Mite, which has a rather convex, purplish red body, and red feet and palpi, and is present in most ponds. The Great Water Mite (*Hydrachna geographica*) is one of the largest species; it has a black, nearly spherical body marked with red spots, and the ends of its legs are red in colour. A rather common Water Mite, called the Harlequin (*Atax histrionica*), has an oval, dark red body, and blackish green palpi and legs. Other Water Mites well worth seeking are the Hunchback (*Arrenurus globator*); the Walking Mite (*Limnochares holosericeus*), which crawls about instead of swimming; the Claret Mite (*Hydrachna cruenta*), which attaches its eggs to the stems of the *Potamogeton;* the Furrowed Mite (*Eylais extendens*), and the Yellow Mite (*Atax lutescens*). To the amateur microscopist the Water Mites will be found a very interesting group for investigation, and will yield a large number of beautiful objects with which to enrich his cabinet of slides.

Attached to the submerged stems of various water-weeds, and more particularly to old stems, we shall find the tiny towers which form the home of the Brickmaker Rotifer; one of the most beautiful and wonderful inhabitants of ponds and slow-moving streams.

The Brickmaker and its tower are of diminutive proportions, and therefore easily escape notice unless careful search be made amongst the tangle of stems. The best plan is to place two or three stems at a time in a wide-mouthed glass jar, and to examine them critically with a hand magnifying glass for the little Rotifer tubes, which rarely exceed an eighth of an inch in length. The selected stems should be carried home in a glass jar or tube filled with water, and then placed in a small aquarium. To appreciate fully the beauties of the Brickmaker, we should place a branch bearing some of the tubes in a zoophyte trough, and examine them under a low-power object glass of the microscope. And what a wonderful sight is then revealed! The tiny tube is seen to be composed of row upon row of minute round pellets or "bricks," each with a central hole. As we watch, a silvery mass is seen slowly to rise from within the tube, and gradually to expand like some dainty, fragile flower. The petals open until the whole reminds us of a miniature, silver pansy blossom.

Around the edges of the shining petals constant movement is taking place, as if some invisible hand were at work, winding a tiny chain. This motion is due to a fringe of delicate hairs, moving

rhythmically, and producing a vortex current which catches, and carries down on to the centre of the flower-like expansion, minute particles of animal and vegetable matter; for these extremely delicate hairs or cilia are the organs with

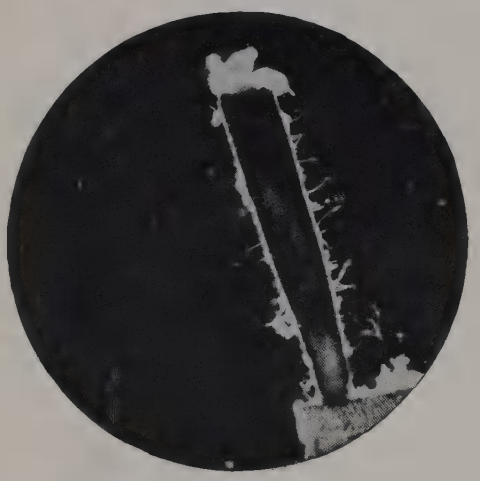


A RED WATER MITE.

which the Rotifer captures its food. Should some larger denizen of the pond flash past, the little flower-like head of the Brickmaker instantly contracts, and disappears within the protecting walls of the tiny tube, only cautiously to reappear when the danger has safely passed.

If we watch very carefully we shall be able to see how it forms the bricks of which its tiny tower is built, and how it places them in position. The bricks are practically composed of the indigestible portion of the Rotifer's food, which is gradually collected round a curious little "stud" on the neck of the animal. When a sufficient supply has been accumulated to form a brick, the Rotifer is seen to elongate its neck, and bending over its flower-like head, bring the neck-stud into contact with the top of the tower, and the newly formed brick is placed in position. With just a little attention to see that the water is kept sufficiently oxygenated, these beautiful and remarkable Brickmaker Rotifers may be kept in a small aquarium for a considerable time, in a healthy and active condition. A very interesting experiment may be carried out, with the exercise of just a little care, by placing a portion of a plant stem to which some young Brickmakers are attached, in a zoophyte trough, and introducing into the water a small quantity of crushed leaves of the water-plant, to which a little aniline stain has been added. Only a very little of the infusion is necessary, and at the end of a few hours, if examined, the tiny tubes which are in process of building will be seen to have one or more tiers of coloured bricks. By this means, and with the exercise of sufficient care in giving a fresh supply of infusion of another colour daily, or every other day, the little Rotifers may be induced to build their towers so that they are composed of layers of different coloured bricks.

One of the most magnificent of the Rotifers to be found attached to the submerged stems and roots of the water-plants is the so-called Crown Animalcule (*Stephanoceras*), which does not surround its body with a tower like the Brickmakers. When seen in a thoroughly vigorous condition, with its wonderful "crown" fully expanded, *Stephanoceras* is one of the most beautiful inhabitants of the pond. Although a large proportion of the Rotifers lead a sedentary



A BRICKMAKER ROTIFER'S "TOWER."

existence, attached by their base to the stem or leaves of some aquatic plant, there are a very large number which lead a roving life, travelling through the

water at a very rapid rate, and which are most curious and interesting to watch under the low powers of a microscope. So transparent are they, that when

TWO FREE-SWIMMING ROTIFERS.

resting for a few moments, so that it is possible to use a higher magnification on the microscope, it is quite easy to discern the whole of their internal anatomy and to watch the process of digestion.

In collecting the stems and roots of the water-plants while seeking for the Brickmaker Rotifers, we are certain also to find some masses of the beautiful *Vorticellæ*, or Bell-animalcules. They are singularly graceful, these frail, minute creatures, with their long, slender, anchoring stems, crowned by their cup-like bodies, the rim of each cup bordered with a fringe of ever-moving hairs. An active group of these Bell-animalcules presents a most extraordinary scene of animation. The slender stems sway gently from side to side, and then suddenly contract into a graceful spiral, only instantly to shoot forth again to their full length, while the fringe of delicate hairs or cilia which surround the edge of the cup-like body are kept in constant motion, producing vortex currents by means of which these interesting creatures capture their prey.

Of extraordinary interest are the fresh-water representatives of the beautiful Moss Animals (*Bryozoa*), of the rock-pools on the seashore. Of the pond-dwelling *Bryozoa* the beautiful *Cristatella* is one of the most remarkable and interesting, distinguished alike for the beauty and number of its tentacular breathing organs, and for its active habits; it creeps slowly, by means of the flattened under surface of the colony, which forms an oval and contractible disc, over the submerged stones and stems. *Lophopus* is another interesting fresh-water Bryozoon, each member of the colony bearing a wonderful series of delicate tentacles arranged like a horseshoe or crescent-shaped crown. These beautiful and interesting creatures are well worth seeking, and are far more numerous in our ponds and streams than is generally supposed. To quote Dr. Allman, who paid so much attention to these fresh-water forms of the *Bryozoa*, they "may be sought in the still and running waters of the land, in the broad river and the rushing stream, in the pure, cold mountain lake, and the stagnant waters of the moory fen. In interest they yield not one jot to their brethren of the sea, and offer to the

LOPHOPUS: A FRESH-WATER MOSS ANIMAL.

naturalist an inexhaustible source of gratification in the beauty of their forms and the wonders of their organisation."

F. MARTIN DUNCAN.

THE CORNISH CLIFFS IN JUNE.
From the Painting by Arthur J. Black.

Photograph by E. J. Wallis, Kew Green.

"IN THE GLADES THE CHASTE WHITE SNOWDROPS, PLEADING FOR SPRING.

VERNAL DAYS

By R. A. STAIG

"Moist, bright, and green, the landscape laughs around."

WHO could say when Spring began? Through the last months of the old year there were touches of new-formed green, and scarcely a day passed without a fresh bloom or a blossom; always something new appearing somewhere: brown moths along the bared hedgerows, the clear-winged gnats whose spring is winter, spots of gold on the wayside whins; each hibernal hour the springtime of some life. There were intervals when thrushes sang. After the first snowfall yellow stars opened on the jasmine; and sweet perfumed flowers, glistening white and rose-pink, clustered around the stiff, leafless mezereon stems. True to its time the lowly aconite, the short stalk with the green frill bearing the golden cup.

Light increasing, and the dulling influence of darkness on the wane. The life-sap rising, plant stem and tree trunk; buds swelling on the branches. The caterpillar quickening in the tiny egg. The "chi-kurr" of the partridge to his mate. Dawns the day of the warmer

wind and the softening of the frostbound earth. Slowly the crisp white covering melts away—what wondrous profusion of young and tender green points peeping above ground! They could not push forth fast enough, all the hosts of little seedlings, all the sprouts of springing

SUNSHINE AND SHADOW IN THE LARCH WOOD.

herbage. Dog-mercury plainly visible among the withered woodland leaves; the flower spathe of the wake-robin hurrying before the arrow-fashioned leaf; and in the glades the chaste white snowdrops, pleading for spring.

Effulgent beamed the fitful sun. Transient rays, not with much power but with magic touch, bringing expectancy upon the face of Nature. "Phew!" whistled the starling, the prolonged exclamatory whistle, and forth from his tuneful throat came the gurgling notes of vernal prophecy, sounds of pure joy. Gladdening to watch him so jubilant in the welcome flood of genial sunshine. Is there any bird more optimistic? No seasonal mood so sullen or so surly that it can crush all hope from out the starling's breast. He broods no cloud, sees ever the blue beyond, expresses it in his tremulous melodies through the dullest hours.

Ethereal mildness, breath of reviving spring; the old fly felt it and staggered forth, weak-jointed and feeble, from the dark crevice in the wall. The passing sunshine hastened the transformation of the bulb tips into white-striped spears and green expanding blades. It warmed the young perennial shoots coming fast about the old shrunken stems and opened the golden discs of the early coltsfoot and the dandelion. It flowered the burn-sides with the lilac-pink of the butterbur, and decked the hillside hazels with drooping yellow catkins.

Some withered leaves rustled mysteriously among the roots of the beech hedge. Cautiously a small quivering snout appeared, sniffing the air with a fine precision. But the grubs would be scarcely fat enough and beetles few, so he would sleep yet awhile: knowing hedgehog!

Clouds of gathering grey blotted out the sun. Suddenly the wind rose, whirling the snowflakes and scattering the finches chittering along the hedgerows. Once again all Nature mantled white, and everywhere a solemn stillness, unbroken save by sounds of muffled wheels and querulous call of bird. And through many days, but little to be pencilled in the record of outdoor life.

With what joy did one hail the unmistakable signs of coming change, the breaking up of the leaden sky into patchy sunlit clouds borne onward on the south-west wind.

It was pleasant to see the sun-tinged raindrops falling, pleasant to feel again the enlivening touch of the balmy breeze. There might yet be storms to come, chilling showers of sleet and tearing,

cutting winds there would be, and the keen night frosts; but the power of spring was over all, unfolding the buds, opening the blossoms, bidding the birds to sing, calling forth the myriad insects. Damascene purple, white, and yellow, the crocus chalices opened in the garden, and presently a bee visited them.

"Ere a leaf is on a bush,
In the time before the thrush
Has a thought about its nest,
Thou wilt come with half a call,
Spreading out thy glossy breast
Telling tales about the sun;
When we've little warmth, or none—
Little humble celandine."

And there were the little tree-creepers,

Photograph by E. J. Wallis, Kew Green.

"STRETCHING AFAR A WAVING SEA OF PALE GREEN SPEARS AND BLAZONED TRUMPETS, MARSHALLED FORTH BY SPRING."

With lengthening spells of favourable temperature the vernal tide flowed steadily forward; a new bud, an expected flower, a welcome voice, all the cherished living things coming out in endless succession, Nature filling in the gaps.

For so long had the woods been bare, dreary, well-nigh deserted, only the disturbed pheasant, the whirr of partridge wings, a hooting owl; and the mosses spreading velvet green. It seemed an age before the celandines bloomed again—first of the woodland flowers—brightening the accustomed places where their heart-shaped leaves had arisen.

feathered mice, spider hunting, working up and round and down the perpendicular trunks, making pivots of their tail feathers. And the charming tits, as nimble as ever, and so many; wherever had they all come from! Flitting from tree to tree, swinging from branch to branch, hanging on the twigs, peering round corners, "chee, zee; chee, zee," an eye here, a peck there, searching every cranny of the bark, restless, inquisitive, prospecting. 'Twere a dull wood without these Pucks of birddom. In full nuptial dress in the clear spring-light, at no other time are the rich hues of their plumage more lovely.

With vesture so gay the tits' love-story began; by-and-bye in the bole they would weave together emerald moss and filaments of wool, cosy nest for the tiny mottled eggs.

In their own way how glad must the larches be to have the warm sun streaming through their branches, casting the shadows of their tall tapering trunks across the shining mossy path. Gradually, as the days passed, had these gaunt conifers gained breadth of sprouting green. Small pink tassels on some of the branches revealed the future cones; others showed the lesser yellowish knobs, waiting for the breeze to carry the pollen gold to the pink. Such is the "wind-love" of the larch.

A sign of the season is the matchless gloss of the starling's coat. It tells of mating time and the happy birds; of "showing off," and rivals to be outdone, and quarrels to be pecked out. Chaffinch, wren, hedge-sparrow, and how many more, all of them too preoccupied to trouble about the vagaries of the weather. Sly goings and comings to and fro, the ditch bank signified an early chosen site. There he was with a fibre in his beak, happy married robin. All day long in the glare and heat of summer the yellow-hammer sings, common notes, commonplace as the dust on the highway; but now so precious every note of the old familiar refrain about the "little bit of bread and *no* cheese," precious as the leafing buds of the hawthorn hedge where he sits.

Light-hearted, up and up a skylark fluttered, soaring far away up where no eye could follow, carolling in the vault of the heavens. No morn now without the joyous lilt of singing bird, the sweet music of the mavis, the blackbird's spirited fluting.

Blustering winds ruffled the feathers of the building rooks, but neither gusts nor lashing hail could stay the progress of the rookery. From the marsh pools "qurk, qurk, qurk" sounds the shrill chorus of the amatory toads, swimming among their long slippery strings of ova. The deep-croaking frogs had forgathered there before them—heavy masses of cold quivering jelly lay in the water, eggs within gelatinous globules; some already hatched, tiny tadpoles. Lethargic under the mud, how did the frogs know when exactly to come forth?

When winter reigned, and all was desolation in the wooded park, it meant so much just to know that those treasuries of floral splendour, the Lent Lily bulbs, were there, beside the roots of the withered grasses, awaiting the call; and then to come again and find the numberless green points newly risen; but later what pleasure inexpressible walking among the trees to view the glorious legions of golden daffodils stretching afar a waving sea of pale green spears and blazoned trumpets, marshalled forth by spring.

Like the ways of the child are the moods of Nature at this season, all smiles and then all tears; but the laughter will out ere the tears are dried. And she has no fixed order for anything, no immovable dates for appearances. You cannot say, "Come, it is sunny, we will go and see the bronze-scaled slow-worms on the bank among the dried brackens, where they were this very day last year." Or was it written in your almanack that the sweet perfumed primroses studded yellow the sheltered dell? And you went there expectant. Only the flower-stalks coming; but violets so lovely, "sweeter than the lids of Juno's eyes, or Cytherea's breath," and there, too, the first frail windflowers, and a brown lizard squat upon a sun-exposed stone.

Big orange-belted bumble bees joined the murmurous brotherhood at the sallows, impatient for the "pussy-cat claws" to open, golden "palms." Earlier than expected, the first sand martins had arrived. So often the unlooked for with Nature; always surprises. One evening it is a bat flitting up and down the avenue; next morning out pops dapper "Squggy" with his beautiful "brush," and someone has found a starling's egg lying unbroken upon the sward, spotless pale blue.

With measured step the sower walks the brown earth acres, casting the seed in handful showers. Over the field the lapwings fly, a swift, smiting flight, "whee-a-weet, pee weet," tumbling, descending, doubling back; again "pee weet," higher, more distant. Their frantic swoops and cries tell of blotched brown eggs exposed in a hollow near at hand. Look and better look, yet they may be

crushed under foot unnoticed, so close is their resemblance to the stones and earth. Before nightfall the farm worker will collect a pitcherful for his supper. No resemblance so subtle that it can long defy the scrutiny of observant man. In the pasture, aloof and motionless, under the lee of the dry stone dyke, stands a ewe with her new-born lamb; one more bleating voice to join in the frolics of spring.

Spring's procession of life rapidly advances in all its wealth of colour and form. Each day brings added pleasures, fresh interests, something new or beautiful or good, the exquisite curl of a fern, the bursting tulip, a spotted ladybird, that "primrose of papilions" the brimstone butterfly, the chiffchaff and the swallow from over the sea, wild cherry blossom—pellucid, waxen white, the golden cup of the marsh marigold, sunshine and the shower softly falling. Along the hedge-banks ground ivy and the bright speedwells are spreading blue. Soon the wild hyacinths, blue and scented, will come again in the woods and coppices, and the cowslips in the meadows. Upon a spray of blossoming blackthorn the chaffinch sings his "toll-toll, pretty-little dé-ár." In his mossy-felted nest in the blossom-laden orchard there are four small reddish-green and purple-spotted eggs.

From dawn to darkness the happy sounds of life, no hour of silence; and in the favoured thickets, all night through, the liquid music of the nightingale, so delightful to the ear. What is pleasanter than, awakened at early dawn, to listen to the medley of bird voices. "Kuh, koo"; distant it seemed; was it fancy? A breathless pause, then unmistakably, so near and loud, "Kuh, koo; Kuh, koo."

R. A. STAIG.

HOW TO KNOW THE TREES GROWING IN BRITAIN

With Notes, descriptive and photographic, for their Identification in all Seasons of the Year

By HENRY IRVING

THE CONIFERS—LARCH, CEDARS, CYPRESSES AND YEW

THE LARCH

THE most distinctive feature with respect to this tree amongst Conifers is that it is not evergreen. For some reason and advantage, it has, in the course of its evolution, acquired the habit, common to most of our trees outside the Conifer group, of casting its leaves as a preliminary to the winter sleep. It is of interest to note that a Larch seedling, during the first four years of its life, is partially evergreen—a surviving reminiscence of the tree's former habit.

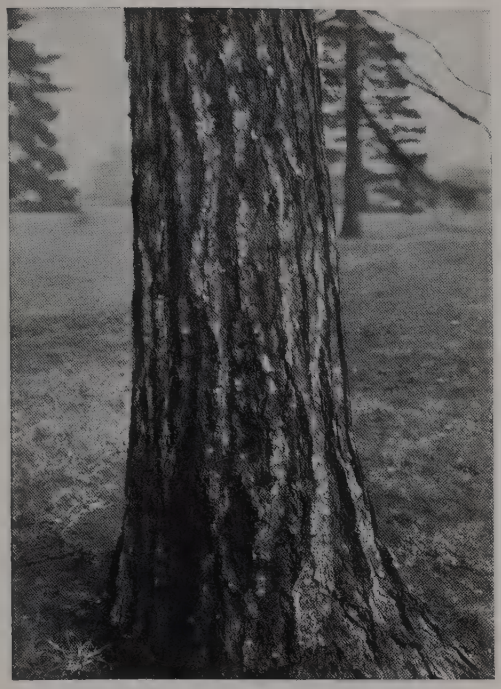
The Larch is pre-eminently a tree of the mountain regions. Its shape is pyramidal, after the manner of the Firs. Its comparatively slight branches emerge in no very defined order from a central, tapering stem. These branches have at first a decided downward tendency, but sweep upwards towards their ends. Along them are ranged many branchlets, vertically suspended, forming a kind of fringe. In winter this tree has a peculiarly desolate appearance, more like that of death than sleep. But in spring there is no tree that awakens, in its vivid emerald robing, to a life more blithe and buoyant.

The bark, which is a reddish grey in colour, flakes off in scales, but also becomes strongly furrowed. The needles are

arranged singly and in a close spiral on the young, long shoots, but elsewhere are in spreading tufts. They are of a very pure shining green in spring, deepening later, and changing to yellow before their fall in autumn. In texture they are soft, not hard and leathery as are those of the evergreens. Each needle is flattened.

LARCH.

The flowers, which appear at the same time as the needles, are oval in shape. The pollen-bearing flowers are yellow, the fruit-producing flowers a purplish red, erect by a manifest effort on the sides of the pendent branchlets. These are what Tennyson refers to as the "rosy plumelets" of the Larch. They are, however, on some trees a greenish white. Since these flowers grow abundantly on the lower branches, and there is, in consequence, no urgent need for the pollen's upward flight, its grains are not equipped with air bladders as is usual with the Pines. The cones, which mature and ripen their seeds in a single season, are about an inch long. Their scales open in the following spring, liberating the winged seeds. These are gradually shaken out by the wind, but



TRUNK AND BARK OF LARCH.

not readily owing to the erect attitude of the cones. The empty cones remain attached for several years, and, so accumulating, add much to the desolate winter aspect of the tree.

THE CEDARS

There are three of these, which are, however, generally regarded as merely geographical varieties. They are all mountain trees, as their names indicate: The Cedar of Lebanon, the Himalayan Cedar (Deodar), the Mount Atlas Cedar.

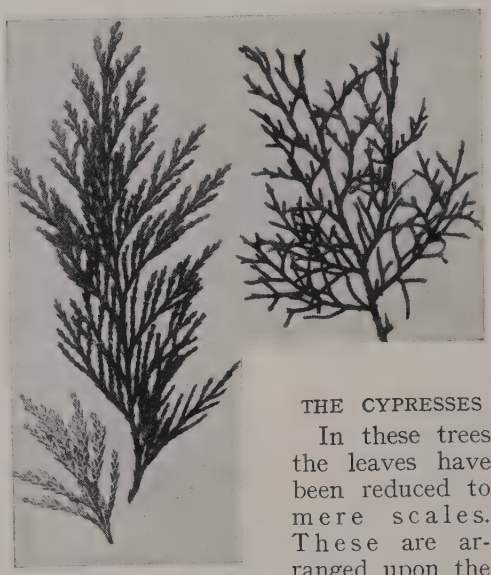
The Cedar of Lebanon, supreme type of venerable majesty among trees, is nevertheless of very variable habit. In its most characteristic form it throws out, at a rather low level, huge lateral limbs, which support at their extremities broad, platform-like areas of foliage, giving to the tree its distinctly terraced appearance. In maturity the summit also is usually broad and flat.

The other Cedars, as they grow in this country, are almost uniformly pyramidal like the Firs. The chief distinction between them is in the fact that, whilst the Deodar has its branches directed downwards, with their terminal shoots pendent, the Atlas Cedar has both its branches and its shoots erect.

The bark, a brownish grey in colour, is deeply broken up and roughened. The needles grow, similarly to those of the Larch, singly on the young, long shoots, in bristling tufts elsewhere. These tufts appear mostly on the sides and upper face of the branch. Each needle is hard and tough in texture, and is four-sided.

The flower clusters, which appear in the autumn, are solitary and erect. Both kinds are found on the same tree. The pollen-bearing flower clusters are particularly conspicuous as yellowish green spikes, contrasting strongly with the expanse of tufted dark green needles. The cones are erect, oval in shape, flattened or bluntly pointed at the top, and of a particularly solid structure. They require two or three years to reach maturity. The seeds are liberated, as in the also erect cone of the Silver Fir, by the shedding of the cone-scales, from the top downwards, leaving on the tree only a bare spike. The seeds are winged.

TRUNK AND BARK OF CEDAR OF LEBANON.



FOLIAGE OF LAWSON CYPRESS (LEFT) AND ROMAN CYPRESS.

THE CYPRESSES

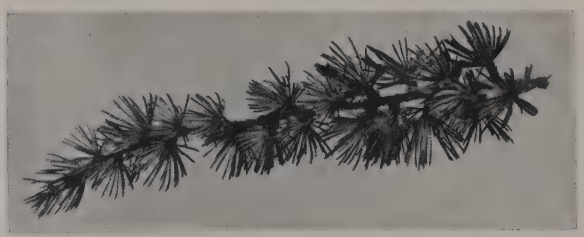
In these trees the leaves have been reduced to mere scales. These are arranged upon the shoots and twigs in opposite pairs, with the alternate pairs at right angles. These fit so closely as completely to ensheath the shoot. The two chief Cypresses with us are the Roman (or Common) Cypress, and the Lawson Cypress.

Their usual form is flame-like, as that of the Lombardy Poplar. The flowers of both kinds are found on the same tree, but on different branches. They are very small, but being grouped more or less at the end of the previous year's shoots, and of distinctive colour, they are fairly conspicuous. The small cones are globular. They have but few scales, and these of a peculiar shape. Each separate scale is like a large-headed nail. The heads of these scales, pressed together and become pentagonal by pressure, form the outer surface of the cone. The cone opens, to liberate the winged seeds, by the separation of these heads of the scales. The Thuyas, which otherwise most closely resemble the Cypresses, are easily distinguished by the absence of this peculiarity in the cone-scales.

The Roman Cypress has its branching close and dense. The shoots and twigs, with their sheathing leaves, are square in section. The pollen-bearing flowers are yellow, the fruit-producing flowers a brownish green. The cones are an inch in diameter.

The Lawson Cypress has a looser branching and a more flattened spray. The shoots, closely ensheathed by the leaves, are flattened also. The margins of the leaves are emphasised by waxy lines, forming a series of markings, V or Y shaped. The pollen-bearing flowers are a bright red, the fruit-producing flowers a steely blue. The cones are about one-third of an inch in diameter. This Cypress, though of recent introduction, is the one now most commonly met with.

FOLIAGE OF YEW.



FOLIAGE OF CEDAR OF LEBANON.

THE YEW

Even apart from its associations this tree cannot be overlooked. Its rounded massive build, its dark evergreen foliage, its columned trunk, often of immense proportions, its air of

CEDAR OF LEBANON.

YEW.

antiquity, distinguish it instantly from all other growths. It is venerable from its association with ancient forms of worship, from its frequent occurrence in near neighbourhood of old church buildings, having, it may be, possessed the ground long before their walls were raised. The imagination is stirred at the thought that, without one hour's cessation, through all seasons and all changes of a thousand years and more, many an ancient Yew, vigorous still, has laid its quiet shadow on its own peculiar spot of sacred earth.

The trunk is really a composite structure.

ROMAN CYPRESS.

Branches growing up from the base have, in course of time, coalesced with the main stem, giving to it its columned character. The bark, which is thin and fibrous, peels off. It is reddish brown in colour. The flattened narrow leaves, solitary, and arranged in a close spiral, assume a combed-out attitude after the manner of those on the Firs. The pollen-bearing flowers, prepared the previous autumn, are attached in clusters to the under sides of the twigs. Their ripened pollen drifts

TRUNK AND BARK OF YEW.

away in clouds when shaken. Like those of the Larch, and for a similar reason, these pollen grains have no air bladder attachments. The fruit-producing flowers, with very rare exceptions, are on separate trees. They are difficult to find, being, in appearance, no more than minute green buds, whose floral structure can only be seen under the lens. The fruit is an olive green seed with a hard shell, partially enclosed, like a young acorn in its cup, within a brilliant scarlet receptacle, the walls of which contain a sickly-sweet mucus. Numerous birds find this attractive, and by their agency the seeds are dispersed.

A variety of this tree, the Irish Yew, frequently seen in gardens, is of columnar shape.

HENRY IRVING.

THE GARDEN SNAIL

By JOHN J. WARD

Author of "Life Histories of Familiar Plants," "Some Nature Biographies," etc.
Illustrated with Photographs by the Author

THE common Garden Snail (*Helix aspersa*) is a strange animal, whose dirty brown and grey shell, slimy exudations, and destructive habits in our gardens, quite alienate it from our sympathy. Nevertheless, the Nature lover may spend many a profitable hour in observing the curious habits of this leisurely-moving and even-paced *Gastropod*—as the zoologist prefers to call it, which, in plain language, means stomach-foot.

THE GARDEN SNAIL.

The lower exposed part of the snail's body consists of a large and broad muscular foot, and by means of this organ its locomotion is accomplished. The curious feature about this foot is that it is never lifted when its owner is moving. Its progress may be ever so closely watched as it glides over a pane of glass, but all that can be observed is a series of muscular undulations passing from back to front as the snail glides slowly forward. Although the snail obviously makes headway, yet just how it travels is a complete mystery; the whole of the time the base of the foot is closely applied to the glass, and is never seen to wrinkle with the forward movement.

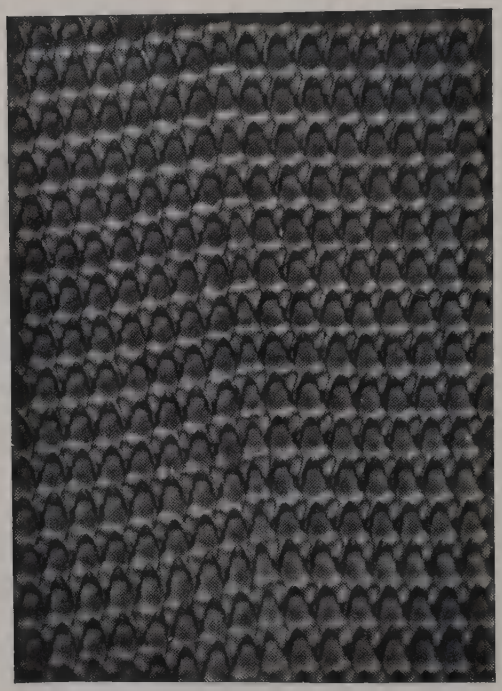
The successive waves, commencing at the posterior end, are seen to travel completely through the substance of the foot to the anterior end, and the foot, therefore, appears to be continually shortening at its base and lengthening its fore part. Of course, the whole body is really moving forward; how the motion is effected science has yet to explain.

Another remarkable feature about the snail's locomotion is that it always travels at the same pace; whether over loose or rough soil, the bark of a tree, a perpendicular wall, or a sheet of glass, the pace is always the same. If it is pursued by an enemy it cannot hurry, neither can it move backwards; its muscular mechanism having been put into use, it must run its course. Its only defence is completely to stop the machinery, as it were, and start another section by which it is withdrawn into its shell.

Seeing that an uneven, a too steep, or a too smooth surface always impedes our progress, it is at first astonishing that the soft body of the snail should maintain its even pace irrespective of differences in the surface over which it moves. It is, however, by means of the slime, or mucus, which it secretes that this equality of motion is obtained. According to the character of the surface in contact with the snail's body a greater or less quantity of this lubricating fluid is deposited, and in this slime the mobile foot always glides with the same amount of friction; hence the pace remains the same.

Around that part of the snail protected by the shell is a thin loose skin known as the *mantle*, and from secretions from the

edges of this organ the shell is built and extended as growth takes place. Likewise, when the gardener gives the snail a chop with his spade and smashes its shell, or throws it forcibly against the wall for the same purpose, from this mantle oozes out the repairing fluids, and so the snail becomes its own surgeon, joins up its broken parts and carefully cements



PORTION OF TONGUE OF EDIBLE SNAIL (*HELIX POMATIA*).

The tongue of the Roman or Edible Snail possesses 140 rows of minute teeth. The total number of teeth is more than 20,000, and these form a rasp that can inflict serious damage upon garden products.

them together again. Then once more it goes on its way rejoicing to take toll from the lettuce plot, or, perhaps, to make one of its destructive forays amongst the young and juicy flower seedlings, and so recoup its strength; thus squaring accounts with the gardener for the injury he inflicted.

Turning to the senses of the snail, it is obvious that its sense of touch is very keen. It will only emerge from its shell in the cool of the evening when moisture and dew begin to accumulate, or after a shower when everything is damp, for moisture is essential to its welfare. When kept quite dry it will often remain sealed up in its shell for weeks and months at a time, showing no sign of life. A little water sprinkled round about it, however, quickly causes it to detach itself from the tree or wall to which it has been clinging, and to glide forth in its slow and dignified manner, first extending its head slightly, and then its great stomach-foot, after which appear the two long "horns," quickly followed by the lower and smaller pair.

It is at the moment when the longer pair of feelers are extended, that the snail takes a peep to see if all is well, for the tiny black specks seen at the tips of the "horns" are its eyes. They wave gently to and fro, but at the slightest danger are retracted into the feelers, and the feelers into the head. Just what kind of a view of its surroundings the snail receives by means of its elevated eyes, we are quite unable to understand. Experiments tend to show that it is very short-sighted. The fact, too, that the retina is very close to the spherical lens, would also point to the same conclusion.

Near the eyes, on the tips of the feelers, are some curious minute skin cells, which are said to possess olfactory functions. The gleaming night-tracks made by the snail over the garden wall to some favourite feeding haunt, may, perhaps, be taken as evidence that the snail possesses a keen sense of smell. A snail will climb the bark of a tree, or a wall, night after night, to reach ripe plums, or other fruit, returning to its regular hiding-place behind the ivy, after its meal; for snails undoubtedly possess a strong homing instinct.

Furthermore, if, when a fully developed snail is seen approaching a ripe pear or plum, the fruit is suddenly removed, the snail will stop short and quickly extend and wave its feelers, as if trying to locate the scent of it. If the fruit is then put in a different place, the snail will often steer directly towards it. Such evidence would seem to prove that the snail possesses very sensitive olfactory organs; but that conclusion does not necessarily follow. The snail may be guided by something other than the sense of smell. If it is that, its olfactory senses are much

more highly developed than our own, for it can locate its food from afar ; and, to us, that food often has no sensible odour.

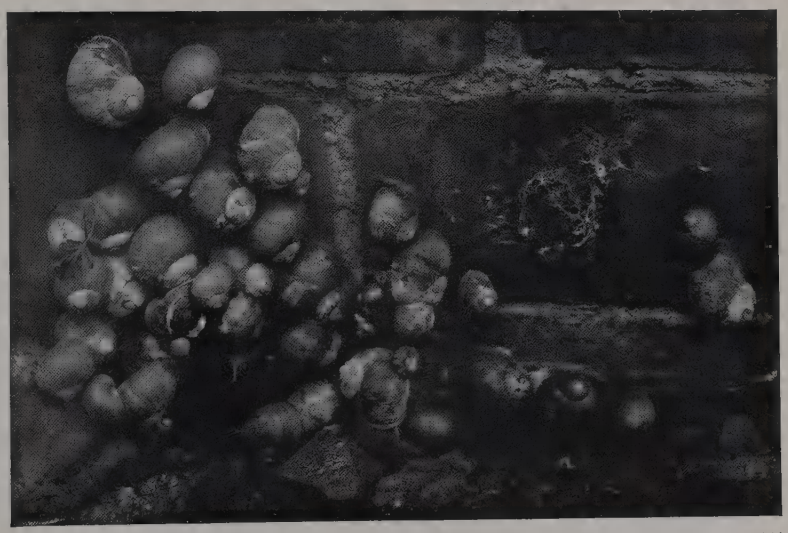
This point well illustrates the danger in drawing analogies from the human body. Seeing that the snail performs many sensory functions that are extraordinary to human comprehension, it is probable that it possesses senses that are not analogous with our own, and of which, consequently, we have no conception.

The snail's organs of hearing, if they exist at all, are most likely located in the upper surface of its foot, but, in any case, they are of a most simple character, and sound, as we know it, seems to have little or no effect upon the snail.

I am not aware that any organs of taste have been located in the snail, but, judging by its decided preference for fruits, peas, beans, and other choice commodities of the garden that are not intended for its use, it seems to possess strongly developed faculties in this direction. It is also assisted in this respect by the possession of most complex mouth-parts. Its tongue is a kind of rasping instrument, a file provided with more than 14,000 teeth in rows of about 100 in each. The thickened lips are pressed against the mushroom or leaf on which it is about to feed, in sucker-like fashion ; then the toothed file, or lingual ribbon, is applied ; and the damage that these numerous minute teeth can perform soon becomes apparent.

Its relation, the Roman or Edible Snail (*Helix pomatia*), which is found in some localities in England, possesses more than 20,000 teeth, some of which I have shown in one of the photographs ; but even that number is comparatively small, for one of its foreign relations is said to own a dental palate bearing 40,000 teeth ; and what is most remarkable in connection with these toothed rasps is that, as the rows of teeth in use wear away, other rows are formed to take their place.

JOHN J. WARD.



GARDEN SNAILS HIBERNATING DURING WINTER AGAINST A WALL THAT HAD BEEN PROTECTED BY A PIECE OF SLATE.

A HAUNT OF BREAM AND ROACH.

BRITISH FRESH-WATER FISH AND THEIR HAUNTS

By WALTER M. GALLICHAN

With Photographs by Mrs. C. G. GALLICHAN

BREAM, ROACH AND RUDD

ON a hot day in summer, when the sight can penetrate six to eight feet of water in a clear river, one may see the Bream at home. This opportunity is, however, somewhat rare, for Bream feed upon or very near the bottom, and they prefer still deeps and holes of streams. In the Norfolk Broads, where Bream abound, it is not easy to catch a glimpse of the broad-sided, silvery fish, because most of the Broads are shallow, and in some of them, such as Hickling, Barton, and Heigham Sounds, the water is bright, and Bream are easily alarmed by the approach of a boat. Wroxham, one of the best of the Broads for the Bream angler, is not so clear as most of the Norfolk meres, but the water where the Bream lie is too deep for one to watch them.

The river that has afforded me the most favourable chance for observing Bream is the Gipping, between Ipswich and Stowmarket. In a mill-pool of this stream I have seen, in June, a shoal of sixty or seventy big Bream feeding near the bottom, and sometimes standing on their heads, while they "rooted" edible morsels from the mud. The Thames holds many good Bream, especially in the lower

reaches above tidal water, and at Hampton, Sunbury and Shepperton; but although in bright weather one may see shoals of Roach, and occasionally barbel, in the Thames, I cannot remember catching sight of a Bream in that river.

Bream belong to the Carp family, and are easily recognised by their depth of side, their silver scales, and a touch of dull red on the fins. They are fond of rivers and pools with a muddy bed, and frequent most of the rivers of Eastern England, some of our canals, and many lakes and ponds in the English counties. They haunt the deep water of the Trent, and are fairly common in the Derwent above Derby.

There is not a very marked difference in the Bream of clear water and those that live in sluggish, discoloured rivers, though this species is subject to slight variation in colour. The White Bream, or Bream Flat, found in Ireland, and in some of the eastern counties of England, has bigger scales than the Common Bream, a tinge of red on the body, and redder fins. Bream from Hickling Broad are said to be more silvery than the Bream of Wroxham, and they are better when cooked. But of the culinary value of Bream there is not much to be said. It is not a toothsome fish, though I have eaten it, with more or less relish, during yachting trips on the Broads. The mud-loving fish, such as the Bream, Carp, Tench and Rudd, are more interesting to fishermen and naturalists than to cooks, but are not of much account in the commercial sense. Sea Bream are dainty fish in comparison with the Bream of fresh water.

The habits of Bream are scarcely so well known as those of other common river fish. It is fairly certain that they spawn somewhat late in the spring, and that they are not in prime condition till well after midsummer. In winter they are sluggish, and seem disinclined to feed freely, though now and again I have caught an odd Bream or two while fishing for Roach in cold weather. As a rule, the hottest days give the biggest "takes" of Bream, which is well for those anglers who take their holidays in August. Frost appears to benumb Bream, and it is probable that, like Carp, they burrow in the mud during severe cold.

A WEEDY HAUNT OF ROACH.

In the height of summer, Bream swim in big companies, and a procession of

these sedate fish may be seen occasionally in shallow meres.

Bream have been caught from English waters up to ten pounds in weight, and they are said to attain occasionally the weight of twelve pounds. Six pounds is a not uncommon weight in Norfolk and Lincolnshire for the well-fed Bream of the Broads and Fen rivers.

A DYKE FREQUENTED BY ROACH AND RUDD.

Roach are of the same family as the Bream. In shape they are less broad; the lower fins are a bright red, and the eyes are tinged with red and gold. The red hue of the Roach is the origin of its name in France, *i.e. rouget*, from *rouge*. "He is a fish of no great reputation for his dainty taste," writes Izaak Walton, in "The Complete Angler." In the Ardennes, Roach often formed the first dish at the hotel where I stayed, and I may say that the skill of the cook rendered the fish quite palatable. If the Roach is not greatly esteemed for its edible quality, it is the fish most valued by bottom anglers in this country and in France. There are enthusiasts who concentrate all their angling cunning and dexterity upon the capture of Roach. In Walton's day, "the great Roaches about London" afforded recreation to the "best Roach anglers," and this holds good to-day. The Thames Roach are extremely wary, and the methods of fishing for these are necessarily "fine."

Roach are widely distributed in our waters, and they thrive in meres, ponds, rivers and canals, selecting in preference those parts of a pool or stream that have a hard gravel bottom. They swim in shoals near the bed of a river, but now and then they come to the surface of the water, and feed upon floating insects. Roach will eat a green, soft weed that grows on weir piles and the submerged roots of trees, and in the lower Thames, this weed is sometimes used as a bait for the angler's hook. Their chief enemy among fish is the Pike, and Eels and Perch consume a number of the fry.

In the summer, Roach are fond of roving, and they may be seen, in companies, exploring the shallow dykes of Norfolk and the Fen district. River Roach are brighter than those bred in ponds. In streams with a quick flow and a gravel bed, they are silvery and handsome. This is the character of the Roach of the Avon and some other Hampshire rivers, which produce very fine specimens.

Roach spawn in the late spring, and at this season their scales are rougher than at other times. They are very prolific fish, and when introduced to ponds often increase so rapidly that they diminish the food supply and degenerate into dwarfs possessed of an extraordinary voracity for bait, and almost devoid of their normal quality of caution. In a favourable environment, Roach sometimes grow to three pounds in weight; but a Roach of two pounds is an angler's prize, and one weighing a pound is considered a good example in the Thames, Trent, Lea, and Severn. Pennant mentions a Roach of five pounds, which was captured in English waters, but there is doubt concerning the accuracy of this writer's records of big fish.

Until about the year 1730 Roach were netted from the Thames opposite the Temple, and at Blackfriars and London Bridges. For very many years the Thames was so polluted below Richmond that few

fish could live in its water; but the capture of more than one variety of fish from among the piles of Blackfriars Bridge, during the rebuilding in 1908, proves that the Thames is becoming a purer stream. Two or three of the London docks seem to have been free from the poison of Thames water until about 1860, for Roach were caught in the Surrey Canal Dock, at Rotherhithe, and in the East and West India Docks.

Photograph by F. Franklin Pike.

A CATCH OF RUDD.

The Rudd, sometimes called the Red Eye, was formerly looked upon as a hybrid, but is now regarded as a distinct species. In Wales, where Rudd are very local, the fish is known as the Rhuddgoch, meaning crimson-red, which well describes the hue of the fins. Rudd are of the Carp family, and the near relations of Roach. They can be distinguished from Roach by the depth of their sides, the nearness of the dorsal fin to the tail, and the brighter colour of the fins. Rudd differ somewhat in their habits from their allies the Roach, for they swim higher in the water, and come more frequently to the surface. They are not so common as Roach, though they abound in some of the Broads and in several meres in various parts of the kingdom. In Ireland the Roach is said to be unknown, but the Rudd inhabits Irish waters. Slapton Ley, in Devonshire, is famous for Rudd, and many are caught from Barton Broad in Norfolk. In Coombes Reservoir, in Derbyshire, in Teeton Reservoir, Northampton, and in Whinfell Tarn, in the Lake District—three dissimilar waters—Rudd are found, but they are most plentiful in the eastern counties.

The "occurrence" of Rudd in Whinfell Tarn, recorded by Mr. John Watson, in "The English Lake District Fisheries," is highly interesting, as this is an upland lake and unlike the mud-bedded Broads of Norfolk. Mr. Watson relates that Dr. Günther has identified the fish as Rudd (*Leuciscus erythrophthalmus*), and that they appear to be mostly a pound in weight. In Teeton Reservoir Rudd are the companions of introduced Trout, and no doubt the fine and rapid growth of

the Trout is due to their feeding upon immature Rudd. Around Ellesmere, in Shropshire, Rudd breed in several pools. They are not natives of the Thames, but some hundreds of the species were turned into the river a year or so ago in the neighbourhood of Weybridge.

The existence of old Rudd ponds in several parts of England seems to prove that our forefathers reared Rudd as they reared Carp, and kept them in "stews" or preserves. It is probable that these ancestors of ours knew some trick of cookery which could make Rudd a presentable fish on the table. Nowadays, Rudd are not esteemed as delicacies.

Rudd spawn at about the same time of the year as Roach. They feed on the bottom as well as upon surface food, but in frosty weather they probably dive into the mud and remain inert. Rudd in the Broads may be seen in bright sunshine, swimming among the stems of the water-lilies, though it is not always easy to conceal oneself from the eyes of the fish. Mr. F. G. Aflalo states that Rudd kept in captivity have been known to feed on small minnows, but it is very doubtful whether they are predatory when living in freedom.

Rudd are the prey of Pike and Perch, and herons capture a few now and then on the shallows. They roam in the summer, and apparently travel two or three times during the day around some of the Broads, for troops of Rudd may be seen frequently passing a given point. In the Kessingland Stream I have noted that Rudd and Roach swim together in shoals in hot weather.

Rudd, in my own experience, are less shy than Roach, and more apt to expose themselves to observation in shallow waters. They are, however, fairly shrewd in meres that are much frequented by fishermen. The haunts of Rudd in the east of England are associated in one's mind with beautiful corners of quiet Broads, where the water-lilies expand their pure petals of white, the swallows flash to and fro, the loosestrife and meadowsweet deck the bank, and the sedge warbler's note is heard among the tall, gently waving reeds. It is pleasant to recline in the boat and to watch the denizens of the clear, shallow water, that swim now and then within sight. And at sunset, when the Broad is lit with gold and crimson, one may see the big Rudd rising here and there at the dancing flies that touch the water with fairy feet.

WALTER M. GALLICHAN.

A RUDD MERE.

THE BROWN RATTON, A LOCAL VARIETY OF *MUS RATTUS*, FORMERLY KNOWN AS THE ALEXANDRINE RAT.

HOW TO KNOW THE WILD ANIMALS

By DOUGLAS ENGLISH, B.A., F.R.P.S.
Author of "Wee Tim'rous Beasties," "Beasties Courageous," etc.

THE RATS AND RATTONS

With Photographs by the Author

IN a previous article I suggested that the old English term "Meadow Mouse" (which has a distinct flavour of its own) should be preferred in popular speech and writing to "Vole." The nomenclature of our British Rats calls for a similar revision, and the necessities of the case would, I think, be best met by the revival of the old term "Ratton." An expression is needed which shall distinguish the species scientifically known as *Mus Rattus*—which is at once cosmopolitan in distribution and bewildering in variety—from the larger and clumsier species, which is scientifically known as *Mus Decumanus*, and popularly—perhaps I should say unpopularly—known as the Common Brown Rat. There are at least three varieties of *Mus Rattus* not uncommonly met with in certain of our seaports, and these I would designate the Blue Ratton, the Black Ratton, and the Brown Ratton. I would reserve the title of Brown Rat for the ubiquitous and unmistakable *Mus Decumanus*, and I would call its melanistic variety the Black Rat.

So far as external form is concerned, I hope that my photographs will enable the reader to distinguish with ease between Rat and Ratton. It will be noticed at once that the latter are built on finer lines than the Rats, that they have more tapering muzzles, longer tails, larger ears, and more prominent eyes. The dimensions of the average Rat are about a third larger than those of the average Ratton. This superiority in size (and a corresponding superiority in strength) has proved the determinant factor in a struggle for

existence between the two species, which is actually in progress, at the present moment, both in Europe and America. Its progress in the past has been marked in many localities, including the British Isles, by the practical annihilation of the unfittest. Apart from the disparity of strength between Rat and Ratton, the prominence of the latter's eyes and ears are a decided handicap to him in battle, and it must also be remembered that the "weeding out" process, which naturally accompanies migration, ensured that the Rattons should be attacked in the first instance by a race of hardy campaigners.

The coloration of the Common Brown Rat hardly needs description. There is generally a sharp differentiation between the grey brown of his back and the white of his belly, and his body fur is decidedly coarse. In the Brown Ratton we find the same colour scheme predominant, though the fur is of much finer texture. In the Blue and Black Rattons the body pelage presents a peculiar metallic sheen, typically bluish in the Blue Ratton and typically greenish in the Black, while the colour of their bellies differs but slightly from that of the sides and upper portions of their bodies.

The history of Rats and Rattons is of great interest. It is certain that Rattons of some kind inhabited Europe before the dawn of history. Remains of the species have been found in West German pile dwellings, and also in Italy, under circumstances which leave no reasonable doubt as to their antiquity. The Brown Ratton first attracted attention during Bonaparte's occupation of Egypt, and was named the Alexandrine Rat by Geoffroy. Until the investigations of De l'Isle in 1865 proved that it was impossible to separate him anatomically from the Blue or Black Rattons, he was regarded as a distinct species. De l'Isle advanced the theory that the Brown Ratton was the primitive type. An interesting series of breeding experiments showed him that the mating of a Black male Ratton with a Brown female produced generally an all-black litter, while the mating of a Brown male with a Black female produced generally a mixed litter in which the darker tint predominated. He further suggested that there was a tendency in parasitic animals of the genus *Mus* to become uniformly dusky in tint and to lose the dark upper-, light under-coloration, which is characteristic of so many wild creatures, and which is held to be protective by reason of the light portions being normally in shadow.

On these grounds he held that the original out-of-doors Ratton was brown above and white below, this being the combination which best suited his normal environment, and that the all-over duskiness of the prevalent European type was an adaptation to indoor surroundings. De l'Isle's theory held its ground for a generation, but it was disputed by Forsyth Major, and it is the latter's view which is now generally preferred. This view is based on the palæontological aspect of the case. It is an observed fact that highland species tend to be darker in colour than lowland species. In cases where a single species includes both highland and lowland varieties the tendency to melanism in the former is marked. It has been observed in the common squirrel, in bats, in meadow mice, and in several species of reptiles and amphibians. If we admit that colour variation is chiefly a matter of climate, and assume, as we are almost certainly justified in assuming, that the climate of N.E. Africa and Arabia in the Quaternary Epoch was similar to that of modern Europe, the probability of the original immigrant Ratton having been as dusky as his modern mid-European descendants becomes an extremely strong one, and the evolution of the Brown Ratton from the primitive black type must be attributed to the gradual climatic change which turned the quaternary moors into sandy deserts.

The incursion of the Brown Rat into Europe occurred less than two hundred years ago, but we know nothing of the causes which impelled him to cross the Volga, nor have we any certain knowledge as to whence, or why, he came. It is practically certain that he did not come from India, where Rattons abound, and it is likely that his original home was considerably further to the East.

His passage of the Volga, which was to be fraught with such grim meaning for the European Rattons, occurred,

RAT AND RATTON.

1. THE COMMON BROWN RAT. 2. THE BLUE RATTON ("OLD ENGLISH BLACK RAT.")
The distinction in size and build can be well seen in these pictures. The heads should especially be compared.

A BLACK RAT.

Probably a melanistic variety of the Common Brown Rat, *Mus Decumanus*, the ears being too small and the nose too blunt for *Mus Rattus*.

according to the Russian naturalist, Pallas, in 1727. A few years later he arrived in England, ship-borne from some unknown port, and, in a hundred years' time, had so taken advantage of the British carrying trade as to have overrun the world. Wherever exigencies of space, or scarcity of food, have brought him into direct conflict with the Ratton, the weaker species has gone to the wall. There is no interbreeding between them, and the ultimate fate of the Ratton at the hands of the Rat is complete extermination. It is probable that the Ratton of this country—the old English Black Rat of two hundred years ago—*was completely exterminated*. Both Rats and Rattons, however, are born sailors (how otherwise can we account for their survival through rough weather when the alternative to being smothered in grain or copra, is being drowned in bilge ?), and it is to the accidental settlements of alien Rattons in our seaports (London being the chief, though most stringent precautions are taken to prevent Rattons getting outside the docks) that we owe the periodical rediscoveries of the "Old English Black Rat."

About ten years ago, in company with Mr. H. C. Brooke, to whom the credit of first distinguishing between the Blue and Black Rattons, and the discovery of the Brown Ratton in this country, is certainly due, I investigated the distribution of Rattons in north-west Kent. It was well known to us that they had existed for a long time previously in Woolwich Arsenal — indeed, I had been informed by one of the oldest employees there in 1888 that they (Black Rats) "had troubled him ever since he could remember"—but we were hardly prepared to find a flourishing colony of Brown, Black, and Blue Rattons so far outside the Arsenal gates as Welling. It was from experiments with specimens from this locality that I satisfied myself that Black and Blue Rattons interbred with each other, but would not interbreed with the Common Brown Rat. Does of all three varieties were very scarce—indeed, I never secured a Brown Ratton doe at all, nor did I succeed in mating a Brown Ratton buck with either a Black or a Blue doe. The shyness and timidity of all the Rattons which passed through my hands was in remarkable contrast to the bold resourcefulness of the Common Brown Rat. A fastidious cleanness was perhaps their most engaging feature—rather than endure a week-old nest they would sleep on bare boards. In view of the close connection between Rattons and plague, a disease which is presumably engendered under peculiarly insanitary conditions, this fact is curious.

It has been conclusively proved by investigations in India that Rattons are highly susceptible to plague. In a paper read before the Bombay Natural History Society (*Journal*, vol. xvi. pt. 2) Captain Liston, of the Indian Medical Service, defines plague as a "rat disease," and classes it, by reason of its being readily communicable to man, in the same category as anthrax, glanders, and hydrophobia. Infection is accomplished through the agency of a definite flea, *Pulex Cheopis*, which, though normally confined to Rattons, will, under stress of hunger, desert its dead or dying host, and fasten, with its stomach full of germs, on the first new host which offers. *Pulex Cheopis* has definite antipathies. He shuns the light; he dislikes oil and tobacco. The danger

of plague infection is therefore materially increased by dark surroundings. People whose callings necessitate the frequent handling of oil are comparatively immune, and the same may be said, though in less certain fashion, of tobacconists. It is comforting to realise that our own Common Brown Rat harbours a different species of flea, *Ceratophyllus fasciatus*, and that a definite connection between the Common Brown Rat and *plague* has yet to be established, though it seems certain that there is a definite connection between the Common Brown Rat and *trichinosis*.

I hold no brief for the Brown Rats. The horror of the Lewisham tragedy in November, 1904 (by no means the first or last of such), when a six weeks old living infant was gnawed to death by these vermin, is fresh in my memory, and no doubt many of my readers will recall the tale of woe from the Gaiety Restaurant, "1728 serviettes behind the wainscot of the band-stand," and many similar tales which provided entertainment for newspaper readers during the construction of Kingsway. Reflection soon shows the serious aspect of these incidents. Serious, too, are the size of the record Rat (Malton, August, 1881, length 23 inches, weight $2\frac{3}{4}$ lbs.), the comparative frequency of the baker's dozen in Rat litters, the reckless courage of the Rat, the athleticism of the Rat, the omnivoracity of the Rat, the cunning of the Rat, and the ubiquity of the Rat. I admit all these counts of the indictment against him, but at the same time I think it right to call attention to the fallacies which underlie the statistics recently advanced by the Incorporated Society for the Destruction of Vermin to show the loss of wealth occasioned by the presence of Rats in this country. Mr. Boelter, a member of the Society's executive committee, reckons the value of a Rat's meals at one farthing per diem, and estimating the number of British rats at 40,000,000, arrives at an annual food bill of fifteen million pounds. I have no quarrel with Mr. Boelter's figures, but I must protest against the assumption that whatever enters a Rat's mouth and passes through his body is a dead loss of wealth to the country. We must put to the credit of our forty million Rats not only their services as scavengers, but also their services as fertilisers. We must further credit them with checking to a very marked extent the excessive increase of furred and feathered vermin smaller than themselves, not to mention insects, reptiles and batrachians. Allowing that even so there will be a considerable balance on the debit side, we must consider the best means of restoring that balance of Nature which we ourselves have allowed to be disturbed. The dangerous increase of Brown Rats in this country is, in my judgment, entirely due to the apathy with which we have permitted the interests of the game preserver to take precedence of the interests of the community. This state of affairs should cease. Badgers, otters, martens, polecats, stoats, weasels, owls, hawks, buzzards, all creatures, in fact, which naturally prey on the *Muridæ*, should be strictly protected for a term of years. Instead of encouraging breeds of dog and cat, which are fit for little else than smirking on show-benches, we should encourage breeds which take naturally to ratting, and which ask nothing more than to be allowed to indulge their proper instincts.

In the present state of affairs traps and

A BLUE RATTON COLLECTING NEST MATERIAL.

ratbanes are about as effective as incantations. Ratbanes, to be of any service, must contain some dangerous poison such as arsenic, strychnine, or cantharides. It is questionable whether their use is legal, and, in any case, it is extremely risky. Practically the only alternative we have to an endeavour to restore Nature's balance by natural means, is the employment of bacteria, and it is this method which has been adopted by the Danish Government. Several different forms of virus are on the market, and it is naturally claimed for all of them that they infect Rats with a specific disease, which is communicated from one Rat to another. However careful the laboratory experiments may have been, and however certain the advertisers of these cultures of bacteria may be of the safety and efficacy of their employment, it is greatly to be hoped that the Incorporated Society for the Destruction of Vermin will hold its zeal so tempered by discretion as to await the final result of the Danish experiments before encouraging any but natural means of suppression in this country. No bacteriologist knows or can pretend to know what the ultimate effect of spreading disease among the forty million Rats, to say nothing of the many times forty million mice and meadow mice in this country, would be. Presumably a large percentage of the rodents affected would die; presumably, too, a certain percentage would recover, and possibly be rendered immune. Efforts would, of course, be made to collect and cremate all the corpses, but how many would actually be collected, and how many would putrefy unseen? The Brown Rat would use his last grain of strength in reaching cover. It is claimed for the bacterial preparations on the market that they are specific to the *Muridæ*. Is anyone bold enough to suggest that *bacillus typhi murium*, or any other bacillus, has been proved innocuous to any and every form of life with which a sick Rat may be brought in contact? It is to be hoped that the Incorporated Society for the Destruction of Vermin will be content for the present to devote its energies to the protection of the furred and feathered enemies of Rats. If the Danish Rats are exterminated by the use of "Ratin," the Society will be able to appraise in a few years' time the result of such extermination; if "Ratin" does not exterminate the Danish Rats, the Society will be at least in a position to determine what it does do.

A BLACK RATTON.

The closeness and smoothness of the fur, which has a green metallic sheen, should be noticed, also the large size of the ear and the great length of the tail.

DOUGLAS ENGLISH.

THE KINSHIP OF PLANTS TO ANIMALS

An interesting theory suggesting that plants possess rudimentary senses

By WALTER P. WRIGHT

THE theory of Mr. Francis Darwin that plants have senses closely akin to those possessed by animals —that they can see, feel and smell— has done more than arouse controversy among scientists ; it has arrested the attention of that large section of the general public which strives to look with seeing eyes into the manifold processes of creation.

The theory is at once picturesque and stimulating. It immediately extends the view and widens the sympathies of mankind. It links plants with humanity in closer bonds. We feel that the flowers which we have cultivated from selfish motives—for the pleasurable sensations which their colour and perfume impart — may well minister to the finer emotions of love and friendship. They are an integral part of the vast, yet simple, evolutionary scheme which has peopled the orbs in the solar system with their myriad forms of life.

Many who may have looked askance at evolution because of an unconquerable repugnance to the association which it entails with the lower forms of animal life may be expected to consider it with sympathy when it not only brings within its scope, but gives new attributes to, beautiful plants. They will look on the sprawling sprays of the wild rose, the snowy cumuli of the Traveller's Joy, the ivory spires of the chestnut, the golden cascades of the laburnum, with a sense of intimacy, of oneness, that can hardly fail to have a far-reaching effect both on their imagination and their hearts.

Photograph by E. J. Wallis, Kew Green.

BIRD OF PARADISE FLOWER (*Strelitzia Regina*).

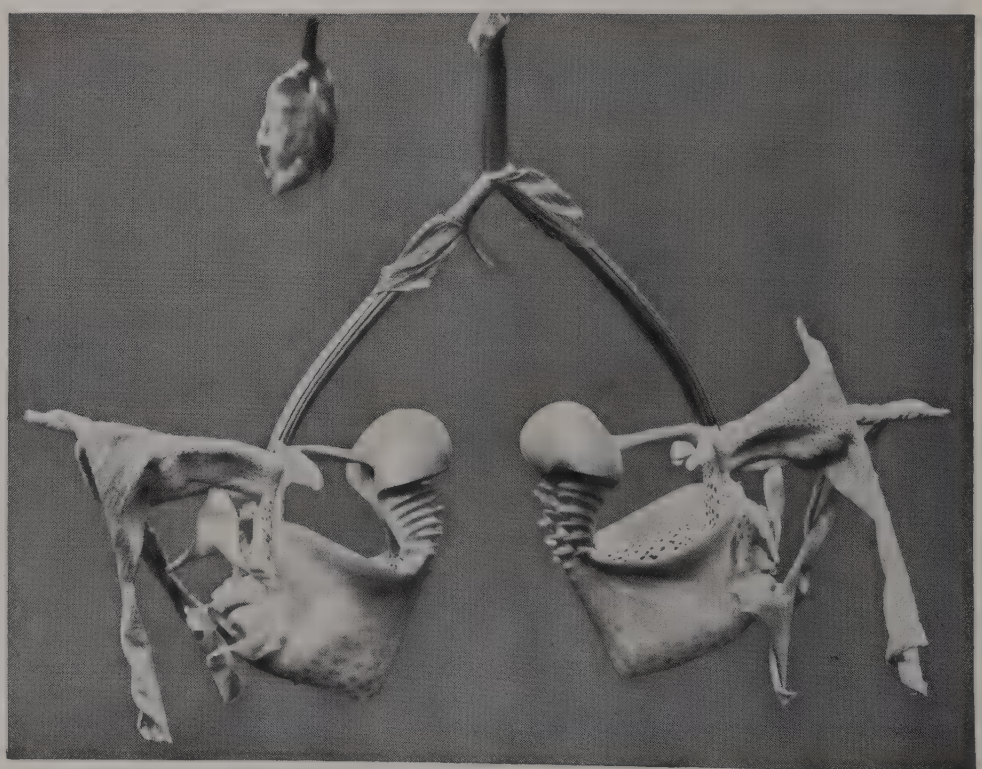
It needs but a very slight study of plants to perceive that there is evidence of intelligence among them which puts them at once on a par with at least the lower animals. They breathe, they move, they simulate other objects, they develop extraordinary and beautiful processes for reproduction, self-preservation and securing nourishment. Roots, stems, leaves and flowers alike appear to be capable of

modification in order to achieve certain objects. These things cannot be accepted as merely fortuitous. They point as clearly to design as the motions of the planets.

Take certain instances of what might be termed peculiarity or eccentricity, but which in some cases might be described as intelligence on the part of plants. I do not think that this word should be withheld because the object which the plant has in view is not apparent to human beings. The five senses of man have hitherto proved wholly inadequate to explain many things which are subjects of common knowledge, but a sidelight may some day serve as a guide.

The great family of Orchids gives us many remarkable examples of plant intelligence. We find flowers of wonderful structure and gorgeous colour. In many instances they mimic animals or insects, in others the various parts of the flower are developed in peculiar ways, which can only be explained as aids to fertilisation. Four extraordinary examples of mimicry are the "Man," "Bee," "Lizard," and "Spider" orchises, which mimic the various animals and insects after which they are named. The "Bee" orchis (*Ophrys apifera*) is familiar to many botanists in this country, who have found it during their rambles, and have been struck by its bee-like form.

An example of the folly of dismissing as fortuitous whatever may be unexplainable at the moment when it is first observed is presented by the exotic orchid known to botanists under the formidable name of *Angræcum sesquipedale*. The waxy, white flowers are five or six inches across, and each is furnished with a spur ten to twelve inches long containing nectar. What was the object of this appurtenance? Botanists looked around, considered, and found nothing to explain it. For many years it remained a mystery. Recently, however, a moth has been discovered in Madagascar, which is the home of the plant, with a specially



THE "BUCKET" ORCHID. *Photograph by E. J. Wallis, Kew Green.*

developed proboscis long enough to reach to the bottom of the spur, and in visiting the flower in search of nectar the insect assists in cross-fertilisation. This is but one of many instances which might be quoted of a relationship between flower and insect too perfectly intimate to be dismissed as "chance."

Photograph by S. L. Bastin, Lyndhurst.

THE PELICAN FLOWER (*Gigas Sturtevantii*).

Singularity and beauty of form are united in the "Lady's Slipper" orchid (*Cypripedium*), the pouch-like flower of which resembles a slipper; in other forms of Cypripedium the side petals of which have developed long, tail-like appendages; in the "Butterfly" orchid (*Oncidium papilio*), with its brown and yellow spotted flowers; and in the "Dove" orchid (*Peristeria elata*), the central portion of which has the outline of a dove.

The *Stanhopeas* are brilliant and fragrant orchids, and they have the peculiarity that the large, waxy flowers are pushed between the roots, and appear below the basket in which the plant is growing. The *Coryanthes* produce their flowers in

the same way. The beautiful blossoms of this orchid (see illustration) have an abnormal development of the lip, which in some instances forms a large pouch, and has led to the name "Bucket" orchid being applied to the plant.

In some orchids certain parts of the flower are very delicately balanced, and are sensitive to the least breath of wind. A remarkable instance of this is *Bulbophyllum barbigerum*, the lip of which is poised with the nicest accuracy, and terminates in a fringe of hairs; as a result the lip is as restless as a two-year-old boy. The *Masdevallias* show a great range of forms, and one of the most singular is that shown in the photograph, *Chimæra backhouseana*.

Among orchids with peculiarities of foliage may be cited *Cynorchis purpurascens*, which has only a single leaf.

Photograph by E. J. Wallis, Kew Green.

MASDEVALLIA; CHIMÆRA BACKHOUSEANA.

Leaving the orchids, we may glance at the curious genus of climbing shrubs known as *Aristolochias*. The flowers are distinguished for peculiarity of shape and offensive odour. There is a hardy species called *sipho*, which is commonly called the Dutchman's Pipe, on account of the shape of the tiny flowers. Then there is the tropical species *macroura*, which produces comparatively small, contorted blooms, the chief peculiarity of which is the elongation of one of the petals. It is two inches across in one part, from which it suddenly narrows into a string-like tail two feet long. The species *brasiliensis* has been called the "Bird's head," and engagingly described by one authority as having "the head of a hawk, the beak of a heron, and the wattles of a Spanish fowl." But the most remarkable of the *Aristolochias* is certainly the "Pelican flower" (*gigas Sturtevantii*), the buds of which resemble a pelican in the water. The expanded flowers are often eighteen inches across, with tail-like appendages three feet long. (See photograph, page 751.)

South Africa gives us a very singular plant in the "Bird of Paradise flower" (*Strelitzia regina*) which is shown in the photograph on page 749. The popular name takes its rise from the curious arrangement of the petals, the beak-like pistil, and the colouring. The petals are orange, and the pistil and stamens deep blue.

The martial title of "Artillery plant" appears, on the face of it, far too formidable for so modest and inoffensive-looking a plant as *Pilea muscosa*. When, however, it sets up a miniature bombardment by discharging pollen in sharp puffs from its stamens the name is seen to be less inappropriate. The device may be one for furthering fertilisation.

WALTER P. WRIGHT.